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Volume 16, Number 7 April 15, 1962

NUCLEAR SCIENCE ABSTRACTS

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GENERAL AND MISCELLANEOUS

7338 (HW-68600-11) PLUTONIUM INFORMATION BULLETIN. VOLUME 2, NUMBER 1. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1, 1962. Contract [AT(45-1)-1350]. 6p.

An annotated bibliography is presented consisting of 17 references to developments in plutonium technology in the fields of chemistry, health and safety, metallurgy and ceramics, and physics. (B.O.G.)

7339 (TID-3709) INFORMAL LISTING OF BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. BIBLIOGRAPHIES ISSUED OR IN PROGRESS DURING THE PERIOD, DECEMBER 1961–JANUARY 1962. (Division of Technical Information Extension, AEC). 27p.

A listing is presented of 159 bibliographies of atomic energy literature issued or in progress during the period December 1961 through January 1962. Author, report number, and subject indexes are included. (M.C.G.)

7340 (XDC-60-4-2) SOVIET SCIENTIFIC AND TECHNICAL LITERATURE. Selected Bibliography, Volume I. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). [nd]. Contract AT(11-1)-171. 346p.

A selected bibliography is presented of Soviet scientific and technical literature. Subject, publication, and translation data are presented for 90 periodicals and 598 monographs. The references are listed in alphabetical order by title of periodical or by last name of first author of monograph. (M.C.G.)

7341 NUCLEAR EXPLOSIONS IN SCIENCE AND TECHNOLOGY. Gerald W. Johnson. Bull. At. Scientists, 16: 155-61(May 1960).

The important scientific and engineering applications of nuclear energy are discussed by describing the various programs using atomic explosions. The programs described are Project Plowshare, Project Chariot, Project Gnome, and Project Oilsand. Other programs under study using atomic explosions are also discussed. (N.W.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

7342 (NP-11250) REPORT OF OBSERVATIONS [ON] NUTRITION: RADIATION AND STERILIZATION OF FOODS FOR DEPARTMENTS OF PHARMACOLOGY AND PATHOLOGY, MEDICAL COLLEGE OF VIRGINIA, RICHMOND, VIRGINIA. F. D. Maurer (Armed Forces Inst. of Pathology, Washington, D. C.). Sept. 15, 1961. 16p.

The diet fed to the dogs in this study included irradiated green beans and fruit compote. There was no evidence noted from the review of the results that the consumption of irradiated green beans or fruit compote, by dogs, produced any histopathologic changes that could be attributed to the specific food or level of irradiation. Lymphocytic thyroiditis, as seen in dogs fed irradiated foods at Georgia Coastal Plain Experiment Station, was evident in one green bean control female. Other thyroid changes were noted in dogs fed this diet and consisted of colloid degeneration and hyperplasia in a 1X male and female and a 2X female. (auth)

7343 (NP-11252) REPORT OF OBSERVATIONS [ON] NUTRITION: RADIATION AND STERILIZATION OF FOODS FOR TEXAS AGRICULTURAL EXPERIMENTAL STATION, COLLEGE STATION, TEXAS. M. A. Ross (Armed Forces Inst. of Pathology, Washington, D. C.). Sept. 15, 1961. 28p.

A report is presented based on histologic review of autopsy material and protocols supplied by the Texas Agricultural Experiment Station. The feeding of unirradiated or irradiated (2 levels) chicken and green beans to rats in a double feeding program is discussed. Four feeding groups were emphasized in the analysis: group 1, control animals, 30 males and 30 females, fed both unirradiated green beans and chicken; group 3, ten males and ten females, fed chicken irradiated at the highest level and unirradiated green beans; group 7, ten males and ten females, fed green beans irradiated at the highest level and unirradiated chicken; and, group 9, ten males and ten females, fed both green beans and chicken, each irradiated at the highest level. Intermediate groups, 2, 4, 5, 6, and 8, were considered whenever there was a suggestion of significant differences. Statistical analysis of the findings in a number of instances was hampered by the lack of adequate data. There was statistical evidence of association of lesions with certain diet groups in a few organs (bone marrow, ovary, and pancreas); however, the inconsistency of the pattern precluded any specific conclusions as to the role of irradiation. (auth)

7344 (NP-11253) REPORT OF OBSERVATIONS [ON] NUTRITION: RADIATION AND STERILIZATION OF FOODS FOR UNIVERSITY OF ILLINOIS, COLLEGE OF VETERINARY MEDICINE, URBANA, ILLINOIS. M. A. Ross (Armed Forces Inst. of Pathology, Washington, D. C.). Sept. 15, 1961. 18p.

The diets fed to the dogs included irradiated beef or flour. There was no evidence noted that the consumption of irradiated beef or flour, by dogs, produced histopathologic changes that could be attributed to the specific food or level of irradiation. A thyroiditis, characterized by infiltration of the gland by lymphoid cells was an outstanding finding. This condition, previously reported as lymphocytic thyroiditis, was present in one-half of the females fed beef (one in each feeding group), and all males fed flour (two in each feeding group). (auth)

7345 (NP-11255) REPORT OF OBSERVATIONS [ON] NUTRITION: RADIATION AND STERILIZATION OF FOODS FOR VIRGINIA AGRICULTURAL EXPERIMENT STATION, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VIRGINIA. F. D. Maurer (Armed Forces Inst. of Pathology, Washington, D. C.). Sept. 15, 1961. 16p.

The diet fed to the dogs in this study included irradiated shrimp or carrots. There was no evidence noted from the review of the results that the consumption of irradiated shrimp or carrots, by dogs, produced any histopathologic changes that can be attributed to the specific food or level of irradiation. (auth)

7346 (TID-14476) MECHANISMS OF UPTAKE OF IONS BY ABOVE GROUND PLANT PARTS AND THEIR SUBSEQUENT TRANSPORT AND REDISTRIBUTION WITHIN THE PLANT. Technical Progress Report, 1961. [(Michigan State Univ., East Lansing)]. Contract AT (11-1)-888. 7p.

Progress is reported in studies on mechanisms of uptake of ions by above-ground plant parts and their subsequent transport and redistribution within the plant. Results are reported from studies on the absorption and transport of Cs^{137} and Sr^{90} in cherry, the distribution of Sr^{90} sprayed on bean plants in the reproductive tissues, the absorption and subsequent incorporation of foliar-applied Cs^{137} and Sr^{90} into the developing fruit of the tomato, the effect of temperature on the foliar absorption and subsequent transport of P^{32} to stems and roots of peas, beans, and tomatoes, and factors affecting the rate of foliar absorption of P^{32}-labeled phosphate by primary leaves of the bean. (C.H.)

7347 (TID-14692) PROGRESS REPORT [ON RADIOBIOLOGY]. Werner P. Koella, C. K. Levy, and J. R. Bergen (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). [1961]. Contract AT(30-1)-2548. 6p.

Results are reviewed of experimental work in radiobiology. The dose-time response aspects of central nervous system responses in mice exposed to dose levels of 0.5 to 50 krad head or whole-body irradiation were studied utilizing a behavioral test for quantitative analysis of neurotoxic compounds. Pretreatment with mercaptoethylamine, serotonin, antihistamines, and lowered oxygen tension failed to afford any protection against the acute response as manifest in alteration in neuromotor ability. Quantitative analysis of the neuromotor effects of supralethal doses of head x-irradiation showed females to be more resistant to acute neuromotor deficit than male mice of the same age and strain. Estrogens significantly decreased acute neuromotor deficit and acute lethality when injected in castrated male mice before irradiation. It was found that migration of unirradiated human polymorphonuclear leukocytes in irradiated plasma was inhibited to the same degree and at the same dose level as cells and plasma irradiated together in vitro. The reduced movement of P observed in rats subjected to x irradiation of the head was interpreted as a manifestation of reduction in P metabolism. Progress is reported in studies on the effect of whole-body x irradiation on histidine decarboxylase activity in the stomach and intestine of rats, the effects of x irradiation of ova at various times pre- and post-fertilization in female hamsters, the possible radioprotective effects of certain estrogen analogs in mice, and the effects of x radiation on the various reactions involved in protein synthesis in rabbit thymus. (C.H.)

7348 (UR-604) HIGH SPECIFIC ACTIVITY LABELING OF PROTEIN WITH I^{131}. William F. Bale, Ralph W. Helmkamp, Thomas P. Davis, Mary Jane Izzo, Ruth L. Goodland, and Irving L. Spar (Rochester, N. Y. Univ. Atomic Energy Project). Dec. 26, 1961. Contract W-7401-eng-49. 36p.

Two procedures efficient in the use of I^{131} for preparing by the ICl method I^{131}-labeled proteins containing up to several hundred millicuries of I^{131} per milligram of protein are described. The essential difference between the procedures is in the means used to eliminate H_2O_2 found in I^{131} preparations of high radioactivity. In the one catalase is used for this purpose, in the other excess Na_2SO_3 with subsequent air-oxidation of the excess to sulfate. It is shown that current methods of I^{131} production of necessity introduce substantial amounts of I^{127} and I^{129} into I^{131} preparations and that the total iodine content sets a practical limit to the specific radioactivity of I^{131}-labeled protein preparations that can be made without undesirable alteration of the protein by excessive iodination. Methods for minimizing the amount of non-I^{131} iodine in I^{131} preparations are discussed. (auth)

7349 IS A RADIOTOXICOLOGICAL APPRAISAL OF FOODSTUFFS POSSIBLE? Georges Michon (Commissariat a l'Energie Atomique, [Paris]). Ann. fals. et expert. chim., 53: 520-31(1960). (CEA-1793). (In French)

The article describes the principles of the main techniques which can be used for finding β or γ emitting radioactive isotopes in foodstuffs. The problem of interpretation is then considered from the point of view of the evaluation, and it is concluded that radiochemical analysis is usually possible and a radiotoxicological appraisal is often not possible. (auth)

7350 INTERACTION OF NORMAL HUMAN SERUM WITH [^{131}I] INSULIN. W. G. Duncombe and Caroline B. Mann (Wellcome Research Labs., Beckenham, Kent, Eng.). Biochem. et Biophys Acta, 56: 193-5(Jan. 1, 1962). (In English)

The addition of I^{131}-labeled insulin to diabetic serum in vitro was used to investigate the fate of insulin in the diabetic subject. Binding of the labelled insulin to γ- or inter $\beta\gamma$-globulins was found in diabetic serum but not in normal serum. Preliminary results are reported from tracer experiments on the interaction of insulin with serum factors, either pre-existing or liberated or activated on incubation at 35°. (C.H.)

7351 RADIORESISTANCE OF FIVE STRAINS OF CLOSTRIDIUM BOTULINUM IN SELECTED FOOD PRODUCTS. E. Wheaton, G. B. Pratt, and J. M. Jackson (American Can Co., Barrington, Ill.). J. Food Sci., 26: 345-50(1961).

Spore recovery counts made on five strains of Clostridium botulinum indicated striking differences in radioresistance. Strain 12885A was most resistant, and strain 32B least resistant. A difference was noted in the survival of spores in five food products (green beans, chicken, codfish, pork, and beef), with green beans providing the most destruction. It was also observed that a given substrate was found to allow a greater per cent survival of one strain than another, so that two strains compared in one food do not always show the same relationship as when compared in another food. Some evidence indicates a modest recovery of viability of the irradiated spores during frozen storage prior to culturing. Since the character of the food determines in part the dose required for the destruction of Cl. botulinum, no single dose would be best for all food products. (auth)

7352 ON THE COUNTING OF TRITIATED THYMIDINE IN TISSUES. Eugene P. Frenkel, Barbara E. Whalley, Charles T. Knorpp, and Donald R. Korst (Veterans Administration Hospital, [Ann Arbor, Mich.], Simpson Memorial Inst., [Ann Arbor, Mich.], and Univ. of Michican, Ann Arbor). J. Lab. Clin. Med., 59: 174-8(Jan. 1962).

The potential versatility of the use of tritiated thymidine for in vivo studies in biologic tissues is limited by the difficulty in counting this weak beta emitter even by liquid scintillation systems. A method of rapid preparation of the tissues and the use of a gel suspension in scintillator is described. This permits ease of handling and efficient counting and yields replicable results. (auth)

7353 EVIDENCE FOR MICRONUCLEAR FUNCTION DURING VEGETATIVE GROWTH AND REPRODUCTION OF THE CILIATE, TETRAHYMENA PYRIFORMIS. Carolyn Wells (Oak Ridge National Lab., Tenn.). J. Protozool., 8: 284-90(1961).

An amicronucleate clone of Tetrahymena pyriformis has been found among the asexual progency of irradiated cells of strain EU 6000 (variety 6, mating type I). Log-phase cells of this clone, designated EU 6525, have a mean generation time (6.0 hr) longer than that of the micronucleate strain, EU 6000 (2.9 hr). Further irradiation studies of strain EU 6000 indicate that the recovery of viable amicronucleate populations is rare although many amicronucleate cells are found among surviving progency. Attempts to introduce micronuclei into amicronucleate cells of strain EU 6525 by conjugation have been made. Micronucleate lines are obtained from amicronucleate pair members only in low frequency. These results, considered together with those of other workers, suggest some change in the state of the cell, additional to the physical loss (or gain) of the micronucleus, must occur before viable amicronucleate clones can be obtained from micronucleate cells, or before amicronucleate cells can produce viable micronucleate lineages. An alteration in mean generation time may be a reflection of this change, or it may simply be a direct consequence of micronuclear removal. The results further imply that the ciliate micronucleus unquestionably contributes information to the cell during asexual growth and reproduction. (auth)

7354 COMPARISON BETWEEN REGISTRATIONS WITH INTEGRATORS AND WITH SCALES IN RADIOCARDIOGRAPHY. C. Giuntini, R. Bianchi, P. Toni, and L. Donato (Università, Pisa, Italy). Minerva Nucleare, 5: 218-24(Sept. 1961). (In Italian)

Counting ratemeters which have the advantage of directly supplying a tracing indicating the counting rate are usually used in radiocardiography. On the other hand, the RC circuit of the ratemeter determines a difference in the recorded function as compared with the actual function; this difference may be considerable in the presence of rapid variations and high values for RC. The laws governing this distortion and the methods for assessing and compensating for it in analyzing the radiocardiogram are described. A method for recording the radiocardiogram based on the use of a sealing circuit is described. This has the advantage that no systematic distortions are introduced in recording the experimental function. The two methods are compared as regards their precision and statistical accuracy. (auth)

7355 EXPERIMENTAL BASES OF THE USE OF RADIOACTIVE COLLOIDS IN THERAPEUTICS. Yves Cohen. Prods. pharm., 16: No. 4, 10p.(Apr. 1961). (CEA-1693). (In French)

The increasing use of radioactive colloids in therapeutics has led to a better understanding of their properties and has made it possible to determine their possibilities and limitations. Chemists have been able to supply products having better-defined characteristics, thanks in particular to the collaboration established between them and the biologists who themselves have been studying the biological properties of these products and relying on their well known chemical and physical characteristics; they have been able to vary these latter as required in the light of the results of the biological studies. Despite all this, colloidal gold remains the most important therapeutic product in this class of medical radiocolloids, and only an extended biological study will make possible the use of other isotopes. (auth)

7356 RADIOAKTIVE ISOTOPE IN DER CHIRURGIE. (Radioactive Isotopes in Surgery). Wilhelm Heim, Werner Schumacher, and Dietrich Frost. Berlin, Walter de Gruyter & Co., 1961. 412p. DM 48.

The physical and clinical aspects of the use of radioisotopes in surgery are discussed. Topics covered include fundamentals in the understanding of radioactivity, the clinically used radiation-measuring apparatus, the biological effects of radiation, surgery for thyroid-gland diseases, radioiodine therapy, the application of radioisotopes for liver diagnosis, tumor diagnosis with radioisotopes, blood volume and circulation diagnosis, determination of circulation time, investigation of shock with radioisotopes, determination of the lifetime of erythrocytes, other methods for the diagnostic application of radioisotopes in surgery, tumor therapy with radioisotopes under surgical viewpoint, therapy of pleura and peritoneal carcinomas, therapy of bladder tumors, therapy of prostatic carcinomas, therapy of portio-carcinomas, pituitary removal in the case of advanced malignant tumor with metastasis, and radiogold-therapy of easily accessible tumors. (M.C.G.)

7357 CLINICAL ASPECTS OF NUCLEAR MEDICINE. SYMPOSIUM IN COLOGNE AND JULICH WITH SPECIAL REFERENCE TO CANCER AND CARDIOVASCULAR DISEASES. Lee E. Farr, H. W. Knipping, and William H. Lewis. Wissenschaftliche Abhandlungen der Arbeitsgemeinschaft für Forschung des Landes Nordrhein-Westfalen. Band 18. Cologne, Westdeutscher Verlag, 1961. 498p. DM 49.

The thirty-one papers presented at the Cologne Symposium on the Clinical Aspects of Nuclear Medicine are compiled. The papers emphasized not only cancer problems, but also subjects concerning clinical cardiology and the equipment of the Medical Department of Julich. Special attention was given to H^3 analysis and experiments made with the gamma-retina. Separate abstracts were prepared for 26 papers. (J.S.R.)

7358 STUDIES ON CEREBRAL BLOOD FLOW IN MAN USING RADIOACTIVE-LABELLED ERYTHROCYTES. G. Nylin, S. Hedlund, and O. Regnstroem (Isotope Research Lab., Stockholm). p.39-48 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In English)

By using the dilution curve technique after injection of labelled red cells, cerebral circulation was studied. It was made possible to determine the cerebral blood flow and to put it in relation to the minute volume of the heart. Also the cerebral blood volume and various parameters of the velocity of cerebral circulation were estimated. The results in healthy men are very constant, while in clinical cases curves of quite different types and prolonged circulation times are obtained. Experiments started with a simplified method using Cr^{51}-labelled erythrocytes and an external counting equipment with a direct recording unit. (auth)

7359 NUCLEAR STUDIES IN MEDICINE: MANGANESE METABOLISM. G. C. Cotzias, D. C. Borg, A. J. Bertinchamps, E. R. Hughes, and P. S. Papavasiliou (Brookhaven National Lab., Upton, N. Y.). p.49-58 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (BNL-5326). (In English)

The importance of manganese as a microconstituent of the body was illustrated. It was pointed out that nuclear techniques have amplified and extended previous knowledge concerning the biology and biochemistry of this element. The studies here presented are applicable to elements other than manganese as well as to systems other than living animals. Hence they were discussed in some detail, with inclusion of both techniques and interpretations of findings. (auth)

7360 MODERN IRRADIATION TECHNIQUES OF BLADDER TUMORS BY RADIOACTIVE ISOTOPES AND HIGH ENERGY X RADIATION. J. Dutreix (Institut G. Roussy, Villejuif, France). p.59-83 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In French)

The radiotherapeutic problems in the treatment of the tumors of the bladder can be solved by three main methods. Endocavitary irradiation is suitable for lesions which are extended but of small thickness. Interstitial implantation is more convenient for relatively thick but limited tumors. External irradiation is necessary for large involvments of the pelvis. The radioactive isotopes and the high energy radiations have introduced a much greater flexibility and accuracy than the conventional methods. (auth)

7361 THERAPY WITH KILOCURIE SOURCES AND THERMAL NEUTRONS. Horst Oppenberg. p.84-106 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

Two examples of the clinical use of artificial radioactive isotopes are discussed: curie teletherapy and neutron capture therapy. The history and present status of curie teletherapy are reviewed. Clinical and technical aspects of Co-60 and Cs-137 teletherapy are compared. They both share common advantages in: treatment of deep seated lesions when the introduction of an adequate tumor dose with conventional apparatus is technically difficult, extensive radiation therapy to be combined with local surgery, retreatment of an area irradiated previously, and introduction of the entire dose through one portal for anatomic reasons with decreased dose to normal structures (i.e., neck). The danger in curie teletherapy is primarily a psychological one, for one may be tempted to give too extensive doses due to minimized skin effects and decreased initial reaction. An example of a relatively uncommon early complication is given (blockade of the lymph vessels with extensive lymphedema). The fact is stressed that the number of cases in which curie teletherapy is of critical advantage is far too small as to significantly alter the cure rates. The development of neutron capture therapy is reviewed and the present technique presented. Though given mainly to patients with medulloblastoma multiforme, extensive laboratory and animal experiments point to future use of neutron capture therapy in other malignancies (i.e., sarcomas). Presently a "cautious optimism" is mentioned. (auth)

7362 RADIOACTIVE TRACER STUDIES OF HAEMOGLOBIN SYNTHESIS, ERYTHROPOIESIS AND RED CELL DESTRUCTION IN CONGENITAL HAEMOLYTIC ANAE-

MIAS. B. Malamos, E. H. Belcher, E. Gyftaki, and D. Binopoulos (Univ. of Athens and Alexandra Hospital, Athens). p.107-24 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In English)

Results of simultaneous radioactive tracer studies with Fe^{59} and Cr^{51} of erythropoiesis and red cell destruction in 30 patients with thalassaemia or sickle-cell anaemia are presented. In studies of erythropoiesis, the clearance of intravenously injected Fe^{59} from the plasma, its turnover by the body tissues, and its incorporation into the circulating red cells were followed. In studies of red cell destruction, the survival of Cr^{51}-labelled red cells in the circulation and the accumulation of Cr^{51} at sites of red cell destruction were followed. Results in thalassaemia support the hypothesis that, in this disease, two groups of erythroid cells are produced, the first being non-viable or having a very short life-span, the second having a moderately shortened life-span, whilst in sickle-cell anaemia, a single group of cells of moderately shortened life-span is produced. Some preliminary results of electrophoretic studies of the incorporation of Fe^{59} into different haemoglobin fractions of circulating red cells are presented. (auth)

7363 BIOLOGICAL AND MEDICAL APPLICATIONS OF ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY. A. J. Bertinchamps (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). p.125-31 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In English)

Electron paramagnetic resonance spectroscopy has proven to be in biology a very important technique for the study of metal complexes, enzyme activity, carcinogenesis, and radiation induced free radicals. A short description is given of the principle of this technique. (auth)

7364 IRON KINETICS IN HAEMOCROMATOSIS. A. M. Baptista (Comissão de Estudos da Energia Nuclear, Lisbon). p.132-41 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In English)

Hemocromatosis is a disease related to an increased uptake of iron which can produce disturbances at the cellular level. Some recent tracer studies on iron kinetics in a few cases of endogenous hemocromatosis have given data which could be of importance for the understanding of the factors which contribute to the metabolic abnormality. In two cases studied it could be shown that most of the iron which leaves the plasma immediately after administration goes to the erythropoietic pool. The deposition of iron in the liver and the spleen can be explained if it is assumed that the iron in the erythropoietic pool goes partly to labeling the erythrocites in the erythron pool and partly to returning to the plasma from the labile pool. This iron now goes to the storage pools. These facts suggest an iron transportation in hemocromatosis which is different from the normal one. (J.S.R.)

7365 CLINICAL EVALUATION OF LATE RADIATION EFFECTS IN A HUMAN POPULATION—WITH SPECIAL REFERENCE TO POSSIBLE CARDIOVASCULAR SYSTEM CHANGES. William Hall Lewis (Brookhaven National Lab., Upton, N. Y. and Sloan Kettering Cancer Center, New York). p.142-59 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In English)

The late radiation effects resulting from the accidental event of radioactive fall-out in the Marshall Islands in March 1954, during experiments on a thermonuclear device, are reported. The purpose of the article is to point out some of the complexities associated with a population study of this type, the approach to the problem, and the organization and planning that are unique to this type of operation. Emphasis is placed on a detailed consideration of the cardiovascular findings five years after the accident for possible late effects of radiation exposure. The group of Marshallese people studied did not show an unusual degree of cardiovascular disease. The types of cardiovascular abnormalities present are described. In an analysis of the amount of aging associated with arteriosclerosis, no changes different from those in more northerly situated people appeared. There were no significant differences in type and degree of cardiovascular abnormalities on comparison of exposed and control adult population groups. The exposure of this population to acute radiation from the fallout has not induced, according to clinical observations made 5 years after the exposure, new or unusual cardiovascular abnormalities. The exposed persons displayed less cardiovascular disease than a comparable control group of unexposed persons. (J.S.R.)

7366 ANALOG COMPUTER METHODS IN STUDIES OF THE KINETIC BEHAVIOR OF LABELED SUBSTANCES. J. S. Robertson (Brookhaven National Lab., Upton, N. Y.). p.160-3 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In English)

The requirements for the use of calculating machines in the analysis of tracer data, and the relative merits of analog and digital computers for this purpose are briefly discussed. An analog computer depending chiefly upon RC circuits is described and its applications to analysis of data obtained in biological systems are mentioned. (auth)

7367 CARBON-14 AS A TRACER FOR METABOLIC STUDIES IN MAN. R. C. De Meutter and W. W. Shreeve (Brookhaven National Lab., Upton, N. Y.). p.164-9 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (BNL-4893). (In English)

Some experience with the utilization of C^{14} for metabolic studies in man are related. Adequate measurements can be made, using doses well below the maximum permissible C^{14} body burdens. Examples are given of studies of glucogenesis performed in diabetic patients. (auth)

7368 EXPERIENCE WITH THE IN VITRO ERYTHROCYTE UPTAKE OF I^{131} LABELED L-TRI-IODOTHYRONINE. P. Kostamis, D. Binopoulos, S. Vatistas, and J. Chalkiadakis (Univ. of Athens and Alexandra Hospital, Athens). p.170-8 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In English)

The in vitro erythrocyte uptake of I^{131}-labeled l-triiodothyronine was performed on 166 subjects. Hyperthyroidism caused a significant elevation, whereas pregnancy caused a significant depression of the uptake. The test is a simple and rapid method of evaluating thyroid function. It is not or only slightly influenced by administration of iodine and may be useful and of practical significance for the purposes of following the effects of therapy in thyroid diseases with I^{131} or thyroid gland. (auth)

7369 A THERMAL PULSE REACTOR FOR MEDICAL PURPOSES. Walter Giesser (BBC-Krupp, Mannheim, Ger.). p.199-211 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

With regard to the future development of medical radiology, a reactor, which is capable of steady-state as well as of transient operation, seems to be the best choice for the application in medicine. In steady-state operation such a type of reactor may be used for the generation of long-lived isotopes and for direct radiation. The transient operation offers many interesting possibilities. For example,

comparing the two types of operation, in the transient operation the exploitation of short-lived isotopes may be improved by orders of magnitude. The physical idea of this reactor type shall be described in a few words. The temperature coefficient of a thermal reactor, generally, has a negative value. This means that an increase of mean temperature results in a decrease of the neutron production. The negative temperature coefficient allows a defined neutron transient controlled by temperature to be obtained. A rapid change of reactivity, e.g., of 5% causes an increase of neutron production above prompt critical level. By this, the neutron flux increases suddenly by orders of magnitude. But now, with some retardation because of the great moderator heat capacity, the mean temperature rises, too. The rise of the mean temperature causes the intervention of the negative temperature coefficient. The neutron flux will rapidly be depressed to zero, if there is no cooling or adding of fuel. The whole procedure happens in a time lag less than a few hundred milliseconds. Thus, in a special example, the time-integrated power is of the order of 10^3 Mwsec. It is hoped that the application of a transient-type reactor for medical purposes will be an important step in the successful development of medical radiology. (auth)

7370 THE GAMMA RETINA. G. Schumacher (Technische Hochschule, Aachen) and A. Scheidweiler. p.232-8 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

The apparatus described has the aim of producing a directly visible picture of the distribution of activity and its change with time. This equipment has been employed for bronchiocardiography with radioxenon and angiocardiography with radioiodine. In conclusion some remarks were made about future developments. (auth)

7371 CYTOSTATICS AND RADIOISOTOPES WITH SPECIAL INVESTIGATIONS ON THE DISTRIBUTION AND EXCRETION OF CYTOSTATICALLY ACTING TRITIUM-LABELED N-MUSTARD DERIVATIVES IN CANCERS. W. Bolt, F. Ritzl, R. Toussaiant, and H. Nahrmann (Medizinische Universitätsklinik, Cologne). p.239-66 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

The advantages of a great number of drugs with cytotoxic anticancer properties in experimental and clinical medicine are reviewed. Factors that must be considered in order to obtain better clinical results with the current cytostatics are discussed, and the purposes of current investigations on cytostatics are reviewed. Results obtained with various tritium-labeled cytostatic agents are then given. (J.S.R.)

7372 RADIODIAGNOSTICS IN LIVER CLINOLOGY. W. Bolt, G. Lehnert, G. Zerlett, and P. Ladendorf (Medizinische Universitätsklinik, Cologne). p.267-95 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

X-ray technique and isotope procedures are essential factors in modern liver diagnostics. In addition to cholangiography and cholecystography the clinician uses other x-ray methods such as splenoportography, arteriography, and venography of the liver. Retrograde sounding of the hepatic veins is especially qualified for assessment of circulatory conditions within the liver. The radioactive procedures in liver conditions are based on two phenomena. First is the principle of clearance examination with the help of indicators which are excreted through the biliary system and second is isotope storage within the reticuloendothelial system of the liver. Determination of the clearance rate of indicators excreted through the bile is an optimal way to get informations about the excretory ability as well as the patency of the biliary passage. The present status of the clearance method with I^{131}-labeled Rose Bengal is briefly demonstrated. An isotope diagnostic method developed in our clinic showed that I^{131}-labeled diodrast is excreted not only by the kidneys but also by the liver. We use this fact of diodrast excretion by the liver cells as a new test of evaluating hepatic function. Our method is based upon the radioactive Rose Bengal test, but it is superior to the latter because of patient's lower exposure to high energy radiation. The usefulness of our method for assessment of liver conditions is demonstrated in some cases. In order to clarify the circulatory condition in various liver diseases, the above mentioned methods with the help of indicators excreted through the biliary system do not appear to be suitable. Better results are obtained by means of a clearance method with NaI^{131} previously published by our team. It is based upon the different outflow of a radioactive substance from tissue with disturbed local circulation after intravenous application of radioactive sodium iodide, as compared with normal conditions. Thus we are able to determine the "local circulation and diffusion"; the earlier methods do not give any information about the conditions of diffusion within the liver. The results of these examinations on healthy persons and patients suffering from liver diseases are discussed. The other procedures applied today for measuring the liver blood flow are based on the fact that radioactive substances are stored in the liver. In this case the isotope retention is a function of blood flow, but disturbances of local diffusion cannot be recognized. The results of these methods are also discussed. The visualization of the configuration and structure of the liver allows us to diagnose liver lesions, such as metastases, cystic defects, etc. We use as indicators in such cases not only radioactive colloids but also substances—e.g., RIHSA—which do not pool during the examination. The radioactive procedures for assessment of liver conditions, known up to now, may complete clinical diagnosis in various ways. Application and further development of these methods may be fruitful objects for future research. (auth)

7373 RADIATION DAMAGE AND RADIATION PROTECTION IN THE CLINIC. H. Valentin and G. Lehnert. p.296-319 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

Because of discussions on the use of radiation in medicine, the position of our present-day knowledge on the hazards of ionizing radiation should be clarified. The chief cause of radiation exposure other than normal background radiation is medical diagnosis or therapy. The principal danger in these medical utilizations comes from gonad exposures which may cause genetic damage. It is concluded that the most rigorous precautions should be taken whenever x rays are used. Their use should be restricted to occasions when diagnosis, therapy, or prognosis demand it. Ultra-sensitive films and appropriate methods of developing them should be introduced. The gonads should be shielded whenever possible. Radioscopies should be avoided and replaced by radiographs. Installations should be improved to guarantee a reduction in the dosage not only for the patient but also for the physician. The application of television and the automatic handling of radioisotopes are suggested. In conclusion the value of radiation in medicine offsets by far the hazards involved so long as the best possible use is made of all the protective resources. (auth)

7374 REGIONAL VENTILATION ANALYSIS WITH THE HELP OF THE RADIOACTIVE RARE GAS XENON-133 (ISOTOPIC THORACOGRAPHY). H. Vernath and

H. Rink. p.320-34 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

Method and clinical application of isotope thoracography are described, and the normal range of values is demonstrated. Examples of patients with lung conditions are presented in whom the isotope thoracogram is compared with datas of lung ventilation and x-ray findings. The most severe impairment of regional ventilation is caused by local stenosis within the bronchial tree and by pleural callosity without difference whether the latter is localized over the apex of the lung, at the base, or at the chest wall. Intrapulmonary conditions which have not led to bronchial narrowing only show an unimportant impairment of regional ventilation. (auth)

7375 CONTRIBUTION OF RADIOMEDICINE TO THE DIAGNOSIS OF LUNG CANCER. E. Liese. p.335-405 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

Summing up extensive attempts to reach an early and differential diagnosis of lung tumors one could state that a true early diagnosis facilitating surgical or radiotherapeutical intervention when the patient's condition is still satisfactory can only be achieved if effective methods are regularly employed in a large number of suspected or predisposed cases. This means primarily that the large number of practicing physicians should think of a malignant lung tumor in the presence of vague symptoms. The improvement in radiographic details using the screen image method will be important. For special studies of the bronchial lumen simultaneous tomography and a special form of bronchography developed by us are useful. Using radioactive isotopes one can examine selectively the gas exchange of certain parts of the lung. Employing isotope circulography it was possible to demonstrate changes of the pulmonary vessels which are frequently present in early cases of bronchial carcinoma. One cannot fully judge the therapeutic possibilities of radioactive isotope incorporation at the present time. (auth)

7376 POSSIBILITIES AND LIMITS OF THYROID DIAGNOSTICS WITH IODINE-131. H. Kutzim. p.406-18 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

The difficulties which, according to clinical experience, arise in evaluating the results of the radioiodine test are presented in detail. They may be due, in certain cases, to a reduced iodine pool, as for example after x-ray treatment or surgical resection of the thyroid gland. In cases of a reduced iodine pool an increased accumulation of I^{131} in the thyroid gland takes place due to an increased specific activity even in those cases in which no hyperthyreosis exists. Since in untreated patients a constant iodine pool may be expected, the test is of great efficiency in differential diagnosis of dysfunction of the thyroid gland. The decreased I^{131} accumulation of the thyroid glands is shown in a case in which inactive iodine had previously been given. The readiness with which the thyroid gland takes up I^{131} in cases of vegetative dystonia is demonstrated in one example. The diagnostic possibility of differentiating hyperthyreosis, euthyreosis, and hypothyreosis from each other by injection of I^{131}-thyroxin and by body-counter measurement is demonstrated in animal experiments. In animal experiments it is further shown, that one may produce hypothyreosis by injections of protein-free thymus gland extract. The possibility of thymogenic origin of hypothyreosis is discussed in this connection. (auth)

7377 TRACER STUDIES ON POLYENOIC ACID SYNTHESIS IN MEN. F. Leupold and G. Kremer. p.419-29 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

Investigations on the influence of polyenoic fatty acids on the blood cholesterol level gained increasing interest in the field of atheromatosis research. Their importance as essential dietary constituents for men is discussed controversely, though it is known for a long time for animals. The trial is undertaken to compare the biosynthesis of polyenoic fatty acids in animal organism with their biosynthesis in human liver and human whole blood, in which it is apparently linked to the leucocytes. This should be the basis for the evaluation of the possible essential character of certain polyenoic fatty acids for men. According to Klenk and Mead the C_{20}- and C_{22}-polyenoic acids originate in the animal from exogenous linoleic and linolenic acid by extension of the carbon chain by acetate units and introduction of new double bonds in the divinylmethane-rythm directed to the carboxylic group. Results obtained from experiments with 1-C^{14} acetate indicate that the formation of polyenoic fatty acids in the human organism proceeds in the same mode both in liver and blood. The requirement of exogenous C_{18}-precursors for polyenoic fatty acid synthesis in the human organism justifies further investigation and discussion on the importance of essential fatty acids for men. (auth)

7378 RADIOISOTOPES IN CARDIOLOGY. Hans Ludes. p.430-42 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

The most important radioactive investigation methods used in heart clinics are described, with special emphasis on coronary diagnosis in the form of the determination of the local heart muscle clearance. (tr-auth)

7379 CONTRIBUTION TO THE QUESTION OF THE FORMATION OF SERUM ALBUMIN BY THE INTESTINAL MUCOSA AND ON THE TRANSPORT FUNCTION OF THE SERUM ALBUMIN FOR SULFUR AMINO ACIDS. H. Schluessel (Universität, Cologne). p.443-53 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

The resorption of a S^{35}-labeled protein in normal food is determined by examining venous blood samples drawn from the intestinal tract. This should lead to a better understanding of serum albumin formation in the intestinal mucosa and the role of serum albumin in the transport of amino acids. In rabbits and dogs an isolated loop of small bowel was filled with an S^{35}-labeled yeast protein suspension. The venous blood was collected quantitatively before it could reach other organs. It then was diffracted by electrophoresis and the S^{35} activity in the paper slip was determined. For reasons of comparison serum albumin was mixed in vitro with yeast hydrolysate or l-methionin and l-cystin (all labeled with S^{35}) and then separated by electrophoresis resulting in different speeds of migration within the mixtures. Following the intestinal encymatic fractionation, the S^{35}-amino acids are transported in a free state by the venous blood of the intestines. Part of the S^{35}-amino acids were found adsorbed rather strongly to the serum albumins. This lead to the conclusion that the liver thus secures the important supply with sulphur groups. A true formation of serum albumin by the intestinal mucosa is unlikely to occur. This cannot be excluded, however, with the method used in this investigation. (auth)

7380 THE RADIOACTIVE ISOTOPE XENON-133 AND ITS APPLICATION IN ISOTOPIC THORACOGRAPHY. P. Endler. p.454-64 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

Radioactive Xe^{133} is an ideal indicator for thoracography. Partial disorders of ventilation may be recognized, as

shown in a series of over 400 patients. Radioactive Xe^{133} can be handled and applied without danger, provided one uses special equipment, such as is described. (auth)

7381 RADIOISOTOPES IN KIDNEY FUNCTION DIAGNOSIS. E. Eysell and F. Franzen. p.483-6 of "Clinical Aspects of Nuclear Medicine." Cologne, Westdeutscher Verlag, 1961. (In German)

The principles and clinical significance of isotope renography are briefly described. The possibility of applying tissue clearance technique to the kidney is discussed. (auth)

7382 IMPROVEMENTS IN OR RELATING TO THE PREPARATION OF ERYTHROPOIETIC FACTOR CONCENTRATES. (to U. S. Atomic Energy Commission). British Patent 886,712. Jan. 10, 1962.

A simple, efficient method is outlined for preparing plasma erythropoietic factor concentrates from anemic plasma. After preliminary treatment of the anemic plasma, which is preferably obtained from sheep injected with phenylhydrazine, it is contacted with an insoluble, high-molecular-weight polysaccharide containing ion exchange groups to effect adsorption of the erythropoietic factor. Elution of the factor is effected by a buffered high-salt-concentration solution. (D.L.C.)

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Refer also to abstract 7704

7383 (HW-70949) PRELIMINARY STUDIES OF INHALED DUST CONTAINING NEPTUNIUM-237. W. J. Bair and A. C. Case (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1961. Contract AT(45-1)-1350. 21p.

Following inhalation of Np^{237} as a contaminant of an industrial dust, about 2% of the total deposited was retained in lungs of rats three weeks after exposure. More than 90% was excreted in feces and about 2% in urine. Liver, kidney, and the carcass retained less than 2%. In 30-day toxicity tests only three deaths occurred in 14 rats at the highest dose level, about 200 picocuries deposited in the lung. Possible kidney damage was indicated in several rats, although histologic changes were marginal. The apparent toxicity was considered to be due to the uranium and fluoride content rather than the Np^{237} content of the dust. (auth)

7384 (TID-14565) METABOLISM OF ALKALINE EARTH METALS. Progress Report, August 1, 1960 through November 30, 1961. Oliver Cope and Benjamin A. Barnes (Harvard Univ., Boston. Medical School). Contract AT(30-1)-2092. 10p.

Preliminary results are reported from comparisons of the exchangeable mass of Mg between alcoholic and control subjects. Techniques employing direct carcass analysis and isotope dilution were employed to evaluate an experimental Mg deficiency in dogs. Mg^{28} was used as a tracer in this study. (C.H.)

7385 ESTIMATION OF MANGANESE IN BIOLOGICAL MATERIAL BY NEUTRON ACTIVATION ANALYSIS. Hamilton Smith (Glasgow Univ. and Western Regional Hospital Board, Glasgow). Anal. Chem., 34: 190-1(Feb. 1962).

Neutron activation analysis combined with chemical separation is a quick, accurate method for the estimation of Mn in small samples of biological materials. After nitric–sulfuric acid digestion of the activated sample, a solvent extraction separation is combined with a colorimetric yield determination. Two modified yield determination and counting techniques are examined. (auth)

7386 DISTRIBUTION OF ^{65}Zn IN THE PROSTATE AND OTHER ORGANS OF MAN. E. Siegel, F. A. Graig, M. M. Crystal, and Elsie P. Siegel (Montefiore Hospital, New York). Brit. J. Cancer, 15: 647-64(Sept. 1961).

The distribution of Zn^{65} was studied in the organs of 14 patients at autopsy, occurring between 1 and 174 days following administration of 100 μc. The greatest concentration of the radioisotope is reached within a few days in the liver (about 0.050 per cent dose/g. wet weight), which localizes about 2 to 8 times more than the pancreas and as much as 10 to 30 times more than muscle. Zn^{65} leaves the liver slowly, 0.013 per cent dose/g. still being present 81 days after infusion. A more rapid turnover of the administered radioisotope occurs in the pancreas. In this organ, the maximum concentration (about 0.023 per cent dose/g.) is attained by the second day; within a week, the level of the tagged metal has fallen by two-thirds, and by 81 days, hardly a tenth remains. The maximum concentration of Zn^{65} in the spleen (0.013 per cent dose/g.) is about half that of the pancreas. For the spleen, as well as for those organs having even lower levels of the radioisotope (seminal vesicles, lung, bladder, and muscle), no temporal relationship could be discerned. The prostatic localization of Zn^{65} was studied by assaying autopsy specimen from 8 of these patients and surgical specimens from 36 others undergoing surgery. For the entire series of 44 patients having normal, hyperplastic, or malignant prostates, the mean Zn^{65} concentration is 0.00992 ± 0.00615 per cent dose/g., ranging between 0.0315 and 0.00150; these Zn^{65} values are second only to those of the liver. No correlation could be demonstrated between the concentration of the radiometal and the condition of the prostate. By assaying samples of different lobes from the hyperplastic glands of 15 patients, marked variation in Zn^{65} concentrations is encountered within the organ unrelated to the anatomical subdivisions. Radioautographs of prostatic sections reveal that the deposition of the radioisotope, which is largely confined to the border epithelial cells, is not uniform. The smaller follicles accumulate the radioisotope predominantly, with both apocrine and holocrine type acini participating. Lesser amounts of the tagged metal are found in the lumens and ducts. Zn^{65} is concentrated principally by the cytoplasm of these border epithelial cells, insignificant amounts being taken up by the nuclei and by the associated connective and muscle tissues. Radioautographs, prepared from bone marrow aspirates obtained about one week after Zn^{65} infusion, show that megakaryocytes and all early forms of the hematopoietic series are very heavily labeled. Mature leukocytes take up some Zn^{65}, but comparatively little of the nuclide is present in the erythrocytes. The distribution pattern of the radioisotope is discussed in relation to stable zinc determinations in man. Our Zn^{65} data are compared also to those reported for experimental animals. Assuming uniform concentration throughout the organ, estimates are made of total organ uptake of Zn^{65}. The maximum accumulation of the administered tracer occurs in skeletal muscle and in liver, while pancreas and prostate have by far the lowest uptake. The effect of some factors on prostatic levels of Zn^{65} is considered. The intracellular deposition of Zn^{65} by the prostate of man is compared to the histochemical studies of stable zinc in man and experimental animals. (auth)

7387 THE LOCALIZATION OF OCTOIODOFLUORESCEIN–I^{131} IN HUMAN BRAIN TUMORS. Edward C. Tocus,

George T. Okita, Joseph P. Evans, and Sean Mullan (Argonne Cancer Research Hospital, Chicago and Univ. of Chicago). Cancer, 15: 153-9(Jan.-Feb. 1962).

The efficiency of I^{131}-labeled, octoiodofluorescein (OIF-I^{131}) as an agent for localizing human brain tumors in situ was investigated using a manually operated scanning device. The dye was found to produce no toxic symptoms in total doses up to 30 mg when given intravenously. Labeled OIF correctly localized the presence or indicated the absence of brain tumors in 34 of 47 (73%) patients in whom diagnoses were subsequently confirmed by surgical methods. In 55 cases confirmed by clinical (nonsurgical) methods, 40, or 73%, were correctly detected. For the combined group of 102 patients, accuracy in localizing brain tumor with OIF-I^{131} was 73%. In a comparative study between OIF-I^{131}, Risa, and DIF-I^{131}, OIF-I^{131} was found to have more favorable biological characteristics for external scanning purposes than the other 2 agents. Scanning with OIF-I^{131} can be performed at any time from 2 to 48 hours after injection, the optimum time being between 5 and 24 hours. The amount of dye found in resected tumor tissue was as much as 10 times that in adjacent normal brain tissue. With the manual scanning technique employed, OIF-I^{131} appears to be useful as a test for the external detection of brain tumors. With a more sensitive automatic scanning device there should be a higher percentage of correct results. (auth)

7388 ABSORPTION OF RADIOACTIVE SULFUR BY THE DIGESTIVE TRACK OF NASSA RETICULATA L. (GASTEROPODA PROSOBRANCHE). Micheline Martoja (Faculté des Sciences, Paris). Compt. rend., 253: 1857-8 (Oct. 23, 1961). (In French)

Radioactive sulfur incorporated in protides is absorbed by a definite region of the intestinal epithelium and by amibocytes. It is accumulated in the peritubular conjunctive tissue of the digestive gland and penetrates only slowly the glandular cells themselves. (tr-auth)

7389 EQUILIBRIUM DISTRIBUTION OF RADIOXENON IN TISSUE: XENON-HEMOGLOBIN ASSOCIATION CURVE. Hadley L. Conn, Jr. (Univ. of Pennsylvania, Philadelphia and Brookhaven National Lab., Upton, N. Y.). J. Appl. Physiol., 16: 1065-70(Nov. 1961).

In vitro and in vivo studies were made of the equilibrium distribution of radioxenon in various organs and tissues of the dog and the xenon uptake compared with a water standard. Tissue-blood partition coefficients were calculated. The radioxenon-hemoglobin association curve was determined for dog and human hemoglobin and methemoglobin. The uptake of radioxenon by blood, due in particular to xenon-hemoglobin affinity, was appreciably greater than uptake either by water or by most other body tissues. Fat and brain were notable exceptions. Consequently, tissue-blood partition coefficients were about eight for fat, one for brain, and significantly less than one for other tissues studied. Acceptable accuracy for blood flow determinations with a radioxenon inert gas diffusion method seem to depend on the use of a partition coefficient correction in turn corrected at least for the existing hemoglobin concentration. The uptake of xenon by hemoglobin had the characteristics of a solubility or a quasi-solubility phenomenon. The problem of the nature of the interaction is apparently not resolved. (auth)

7390 MEASUREMENT OF IRON ABSORPTION IN RATS WITH A PLASTIC SCINTILLATOR. Leon Ellenbogen and Derek R. Highley (American Cyanamid Co., Pearl River, N. Y.). J. Appl. Physiol., 16: 1126-8(Nov. 1961).

The use of a plastic well scintillator for rapidly measuring whole-body Fe^{59} with a counting efficiency of 18% is reported. The application of the technique for studying the effect of various substances on the gastrointestinal absorption of iron in the rat is also described. It was shown that the amount of iron absorbed in the liver, spleen, and bone marrow from 5 consecutive doses is considerably greater in iron deficient-rats than in iron-loaded rats. Numerous substances were also investigated for their effect on iron absorption. Sorbitol, glucosamine, polyoxyethylene sorbitan monolaurate, and L-sorbose enhanced the iron absorption, while sodium terephthalate, imidazole, and benzimidazole demonstrated an inhibitive effect. (P.C.H.)

7391 THERAPY OF POLYCYTHEMIA VERA WITH RADIOYTTRIUM (Y-90). Joseph Greenberg, Arthur Sawitsky, H. C. Dudley, Robert N. Levy, and Kanti R. Rai (Long Island Jewish Hospital, New Hyde Park, N. Y.). J. Nuclear Med., 3: 18-25(Jan. 1962).

Nine patients with polycythemia vera were treated from 5-17 months ago with a single intravenous injection of chelated radioactive yttrium (Y-90) in dosages ranging from 0.10 to 0.25 mc/kg of body weight. An excellent response, both clinical and hematologic, was obtained in all the patients. This includes relief of symptoms, regression of organomegaly, and normalization of the hematologic picture. Two of these patients, treated 16 and 9 months ago, may possibly be going into relapse. The others are continuing in essentially complete remission. Toxicity was limited to transient petechiosis and epistaxis, from which recovery was spontaneous. (auth)

7392 EXPERIMENTAL STUDIES FOR SCINTILLATION SCANNING OF THE PANCREAS. Robert H. Greenlaw, William H. Strain, Thomas E. Callear, Louis D. Dubilier, and Sally C. Strain (Univ. of Rochester, N. Y.). J. Nuclear Med., 3: 47-50(Jan. 1962).

Radiozinc chelates with each of the naturally occurring amino acids were examined as tracers for scintillation scanning of the pancreas. The studies were made by tissue counts following intravenous administration of the chelates to fasted, male, adult rats. Glycine radiozinc accumulates most successfully in the pancreas to give radiozinc concentrations twice those found in the liver. Simultaneous administration of stable zinc gluconate with the glycine radiozinc increases the pancreas concentration to 3.6 times that of the liver. (auth)

7393 MYOCARDIAL SCANNING WITH RUBIDIUM-86. Edward A. Carr, Jr., William H. Beierwaltes, Audrey V. Wegst, and John D. Bartlett, Jr. (Univ. of Michigan, Ann Arbor). J. Nuclear Med., 3: 76-82(Jan. 1962).

Results are given of an investigation of the possible use of Rb^{86} for photoscanning the myocardium in vivo. The experiments included injection of Rb^{86} into dogs, sacrifice, and counting of radioactivity in tissue samples, with scintiscanning performed before and/or after sacrifice. The results show that the radioactivity concentration in the dog thoracic area after a tracer dose of Rb^{86} is primarily in the myocardium and the liver. The heart's blood contributes negligibly to the cardiac scintigram. The projection of the heart area was sharply localized under the conditions used. (P.C.H.)

7394 IN VIVO MEASUREMENT BY THE WHOLE-BODY GAMMA SPECTROMETER OF THE DEGRADATION RATE OF I^{131}-LABELED NORMAL ALBUMIN. Stuart W. Lippincott, Stanton H. Cohn, James S. Robertson, and Lee E. Farr (Brookhaven National Lab., Upton, N. Y.). Lab. Invest., 10: 481-91(May-June 1961).

A new method is described for determining the half-life

of I^{131}-labeled albumin in the body through the use of the in vivo whole-body gamma spectrometer. The results obtained by this technic compare very well with those obtained by calculation from serum and urinary excretion radioactivity concentrations. It is evident from previous work that to obtain a valid biologic half-life for albumin, observations must be made over a sufficiently long period to permit the ultimate slope of the curve to appear. For such a long-term study, the whole-body counting method provides the only technic consistent with the use of low levels of tracer materials. The advantages of the whole-body counting method are the elimination of serial blood sampling and collection of excreta for radiochemical analysis, direct determination of body content rather than estimation by difference or extrapolation from fractional measurement, and utilization for tracer studies of very low levels of an internally deposited gamma emitter over long periods. (auth)

7395 THE DISTRIBUTION OF CANCEROGENIC DOSES OF Sr^{89} IN THE SKELETON OF RATS AND MICE. Malcolm Vye, Gloria E. Zander-Principati, and Joseph F. Kuzma (Marquette Univ., Milwaukee). Lab. Invest., 10: 514-18(May-June 1961).

Radiostrontium injected into rats and mice is distributed throughout the skeleton in a nonuniform manner. Average concentration in particular bones was determined in the present study. The pattern of distribution is different in the two species. However, most of the tumors develop in the long bones in a manner that cannot be predicted on the basis of average concentration in individual bones. The part played by redistribution of strontium, high and low concentrations within a bone, inherent metabolic differences in individual bones, and geometric configuration of specific bones was not determined. (auth)

7396 EXTERNAL COUNTING OVER THE SPINE: IMPORTANCE OF GEOMETRICAL FACTORS. P. Scoccianti (Università, Florence). Minerva Nucleare, 5: 216-18 (Sept. 1961). (In Italian)

The possible interference of geometrical factors in external counting over the spine is considered and discussed. It is advisable to measure the uptake of a γ-emitting bone-seeker isotope instead of actual scanning in order to obtain reliable data as to the mineral metabolism of bone in normal and pathologic conditions of the spine. (auth)

7397 CONCENTRATION OF INHALED CERIUM-144 IN PULMONARY LYMPH NODES OF HUMAN BEINGS. K. Liebscher, T. Schoenfeld, and A. Schaller (Universität, Vienna). Nature, 192: 1308(Dec. 30, 1961).

The concentration of Ce^{144} was investigated in the pulmonary lymph nodes and lungs of deceased persons who had lived in Vienna for several years and died there. The lungs investigated were obtained from persons who had inhaled the radioactive aerosol produced in nuclear test explosions in recent years. The major part of the Ce^{144} was probably produced in the high-yield test explosions carried out in 1957 and 1958. The Ce^{144} activities found in the lymph nodes were between $1/8$ and $1/3$ of the activities of the lungs. An increase in specific activity of one to two orders of magnitude was found. The data are tabulated. (P.C.H.)

7398 NUTRITIONAL REQUIREMENTS FOR THE CULTIVATION OF FULLY DEUTERATED YEASTS TORULOPSIS UTILIS AND SACCHAROMYCES CEREVISIAE. V. S. Mohan, H. L. Crespi, and J. J. Katz (Argonne National Lab., Ill.). Nature, 193: 189-90(Jan. 13, 1962).

The effects of 99.6% D_2O on the growth of two species of yeast were investigated. Torulopsis utilis was found to require thiamine in addition to the D_2O nutrient medium containing inorganic salts, ammonium sulfate, and glucose, and supplementation with cocarboxylase or the thiazole moiety of the thiamine molecule was also effective but supplementation with the pyrimidine moiety was not. However, after several successive subcultures in D_2O, the yeast cells still retain their capability for thiamine biosynthesis in H_2O. Similar work with Saccharomyces cerevisiae in D_2O medium indicates that this yeast requires inositol and pyridoxine in addition to thiamine. It is concluded that the substitution of D_2O for H_2O impairs the capabilities of these yeasts for the biosynthesis of some vitamins. (D.L.C.)

7399 EVIDENCE OF A BARRIER TO LATERAL PENETRATION OF P-32 ACROSS ROOTS OF INTACT TRANSPIRING PLANTS, BASED ON MEASUREMENTS OF XYLEM STREAM COMPOSITION. Fred H. Emmert (Univ. of Connecticut, Storrs). Physiol. Plantarum, 14: 478-87(1961). (In English)

Quantitative aspects of lateral penetration of P^{32} across roots of intact transpiring bean plants were investigated by measuring isotope which reached the xylem stream. Plants were grown to treatment size under controlled environment and nutrient conditions, and were then placed in a treatment solution containing P^{32}. Isotope which appeared in petiole, epicotyl, and hypocotyl samples over a 20 minute period was measured. Xylem stream P^{32} was at least partially separated from the metabolic fraction by subjecting only the sample to low temperature. Time course buildup of P^{32} in test samples following a distinct two-phase pattern. The first phase was an abrupt rise in sample activity 2 to 4 min following root introduction of isotope. This rise was not sensitive to sample temperature, and was attributed to initial passage of the isotope front through the samples. Buildup which occurred in the post 4 min period was in part sensitive to sample temperature. Reductions which occurred as a result of 3°C sample temperature were believed to represent isotope metabolically accumulated within the sample. Remaining activity was attributed to isotope in the xylem stream and to an unknown "X" fraction. Xylem volume of test samples was determined. Calculations were then made of activities which could be expected in the time course studies had composition of the ingoing stream not changed with respect to P-32. Results indicated that the bulk of P-32 was removed from the ingoing stream before reaching the test samples. The rapidity and efficiency with which the isotope was removed from the stream indicated that functional depletion was not the primary process involved. Suggestion was made of a specific barrier to transpiration passage of P^{32} across the root. (auth)

7400 INFLUENCE OF Ca AND Sr AMENDMENTS ON Sr^{90} UPTAKE BY LADINO CLOVER UPON PROLONGED CROPPING. E. M. Romney, G. V. Alexander, H. Nishita, and K. H. Larson (Univ. of California, Los Angeles). Soil Sci. Soc. Am. Proc., 25: 299-301(July-Aug. 1961). (UCLA-462)

Prolonged cropping experiments showed that a single application of $CaCO_3$ in the amount recommended to produce better crop growth (2 to 5 tons an acre) continued to suppress Sr^{90} uptake from an acidic soil that initially was deficient in plant-available Ca. This effect of treatment is attributable to the complementary ion influence of Ca on Sr. The cumulative amount of Sr^{90} removed by 15 successive cuttings of ladino clover was 29.38, 15.71, and 11.61% of the dose from Sassafras sandy loam treated with $CaCO_3$ at levels of 1, 5, and 10 mc Ca per 100 g soil (equivalent to 0.5, 2.5 and 10 tons $CaCO_3$ an acre, respectively). The greatest amount of the Sr^{90} dose removed from the soil

by a single clover cutting was 0.38% at the 1 mc Ca treatment. A single application of $Sr(NO_3)_2$ amendment at levels of 0.05, 1, and 2 mc Sr per 100 g soil (equivalent to 0.05, 1 and 2 tons $Sr(NO_3)_2$ an acre) initially increased plant uptake of Sr^{90} from Hanford sandy loam as a result of the displacement of Sr^{90} from the exchange complex by stable Sr into the soil solution where it was more readily available to the plant. This enhancing effect of low levels of Sr amendment on Sr^{90} uptake became less apparent as time progressed. The carrier-dilution effect of reducing plant uptake of Sr^{90} from Hanford sandy loam was achieved by applying $Sr(NO_3)_2$ at a level of 10 mc Sr per 100 g soil (equivalent to 10 tons $Sr(NO_3)_2$ an acre). (auth)

7401 AGENTS EFFECTING THE REMOVAL OF SKELETAL RADIOCALCIUM AND RADIOPHOSPHORUS FROM INTACT AND PARATHYROIDECTOMIZED RATS. Irwin Clark (Columbia Univ., New York). p.183-96 of "The Parathyroids." Springfield, Illinois, Charles C. Thomas, 1961.

White, male Holtzmann rats, weighing between 80 and 90 grams, were injected with 100 μc of Ca^{45} intraperitoneally and 166 μc of P^{32} subcutaneously at the same time. After allowing a sufficient period for the isotopes to become deeply embedded in the bone mineral (45 to 50 days), the parathyroid glands were removed from half the rats by electrocautery. This resulted in a more rapid exchange of calcium and phosphorus between bone and tissue fluids than in intact rats. It was found that less calcium and phosphorus is excreted by aparathyroid rats. Calcium or phosphorus may be singly withdrawn from bone mineral in vivo, at least for short periods of time. Magnesium, citrate, vitamin D, and parathyroid extracts preferentially remove calcium from bone, whereas vitamin A removes phosphorus. The citrate ion appears to have a dual action on calcium metabolism. (P.C.H.)

Fallout and Ecology

7402 (ORNL-3172) USE OF ANALOG COMPUTERS FOR SIMULATING THE MOVEMENT OF ISOTOPES IN ECOLOGICAL SYSTEMS (thesis). R. B. Neel and J. S. Olson (Oak Ridge National Lab., Tenn.). Jan. 24, 1962. Contract W-7405-eng-26. 123p.

Submitted to Vanderbilt Univ., Nashville.

Linear differential equations and elementary analog computer techniques were applied to the movement of carbon and C^{14} in simple compartment models for a terrestrial ecological system (including soil, organic litter, plant roots, and above-ground vegetation). Extensions of these methods should become helpful in simulating the movement of other elements and radioactive isotopes in the environment. The parameter k_i controls the rate of loss of material from compartment i; the steady-state level for that compartment and the time required to approach that level are inversely proportional to k_i. "Partial transfer coefficients" ϕ_{ij} describe the fractional allocation of material from compartment i to various other compartments or pathways indexed by j, and hence influence the flux of material into compartments remote from the source. Changes in the concentration per unit area C_j per unit time t are represented by solutions to systems of equations of the form: $dC_j/dt = \Sigma_{i \neq j} \phi_{ij} k_i C_i - k_j C_j$ where $0 \leq k \leq 1$; $0 \leq \phi \leq 1$. Analytical solutions and analog computer chart records for a sequence of compartments were compared. They show a series of linear lags in the approach of each compartment toward a steady-state. An oscillating photosynthetic input (seasonal cycle) imposes an oscillating response, but with decreasing amplitude and shift of phase with each stage. Exponential transient terms in the input (representing trend over several years) modify the lags of successive compartments. A small electronic analog computer (Donner 3400) illustrated effects of varying k_i parameters on the behavior of a small model system. A large computer, the Reactor Controls Analog Computer Facility, was more versatile and offers far more technical possibilities for future ecological studies. A function generator was used to simulate the expected increase in C^{14} content of the atmosphere as a result of nuclear testing. The transmission of this pulse of C^{14} through the ecological system showed the effects of lag and attenuation in the pulses of C^{14} in each compartment of the system. (auth)

Radiation Effects on Living Tissues

7403 (A/AC.82/G/L.647) RESEARCH ON FUNDAMENTAL RADIOBIOLOGY AND SOMATIC EFFECTS OF RADIATION OF GERMANY 1954–1960. Otto Hug (Munich. Universität). Feb. 17, 1961. 68p.

The survey includes studies on primary physico-chemical events during the absorption of ionizing radiation, radiochemistry, cytology, somatic effects of radiation on entities of multi-cellular organisms, time factors in radiation effects, volume doses, special features of biological radiation effects of radionuclides, and dose equivalent of radiation ionizing in different density. 84 references. (B.O.G.)

7404 (A/AC.82/G/L.648) MAJOR RADIOGENETICAL STUDIES CARRIED OUT IN THE FEDERAL REPUBLIC OF GERMANY DURING 1953 TO 1960. H. Marquardt, comp. (Freiburg i. B. Universität. Forstbotanische Institut). Mar. 30, 1961. 9p.

Mutations of megaspores. Summaries are presented of studies of: development stages of megaspores in Drosophila; relative genetic effectiveness of various types of radiation; radioinduced mutations and radiation-protection substances; combined tests with x rays and chemicals; radiation cytology; fertility, number of embryos per brood, and mutations in mice; mutation-producing chemicals in human environs; mutations in agricultural crops; and induction of mutations by incorporation of radioisotopes. Somatic Effects. Summaries are included for studies of: radiation biology, radiation genetics, and somatic mutations. References are listed for each of the individual studies. (B.O.G.)

7405 (BNL-675) FUNDAMENTAL ASPECTS OF RADIOSENSITIVITY. REPORT OF SYMPOSIUM HELD JUNE 5-7, 1961. Brookhaven Symposia in Biology Number 14. (Brookhaven National Lab., Upton, N. Y.). Contract AT-30-2-GEN-16. 315p.

Fifteen papers were included which treat radiosensitivity at the molecular, cellular, and tissue levels and during development. Emphasis is placed on radiosensitivity differences between different species and stages in the same species. Separate abstracts were prepared for all the papers. (D.L.C.)

7406 (BNL-675(p.1-17)) MACROMOLECULAR RADIOSENSITIVITY. Richard Setlow (Oak Ridge National Lab., Tenn.).

The actions of ionizing and ultraviolet radiation on organized and disorganized polynucleotides are described from the viewpoint of structure. It is shown that action spectra for the destruction of particular biological properties allow determination of whether the structure consists

of organized or disorganized polynucleotide chains. Such an analysis was applied to the development of intracellular T2 phage and intracellular Φ X174 phage. The experimental data indicate that photoreactivation after ultraviolet inactivation takes place only if there is interaction between the bases of single polynucleotide strands. These latter interactions may be much fewer and weaker than those in organized multiple-stranded polynucleotides. A group discussion is included. (auth)

7407 (BNL-675(p.18-31)) FACTORS AFFECTING RADIATION INJURY TO DNA IN BACTERIA AND BACTERIOPHAGE SYSTEMS. Paul Howard-Flanders (Yale Univ., New Haven. School of Medicine).

Evidence indicates that the radioinduced loss of reproductive capacity in biological systems is due to DNA injury. Chemical and enzymatic effects on DNA inactivation are discussed. (D.L.C.)

7408 (BNL-675(p.32-52)) RADIOSENSITIVITY OF BIOCHEMICAL PROCESSES. Lola S. Kelly (California. Univ., Berkeley. Donner Lab.).

Some possible biochemical bases for differences in radiosensitivity are outlined. A few recent findings on radiosensitivity of DNA, RNA, and protein synthesis are discussed. (D.L.C.)

7409 (BNL-675(p.53-61)) RADIOSENSITIVITY AND THE PROBLEM OF CHROMOSOME BREAKAGE AND REJOINING. Timothy Merz, C. P. Swanson, and C. N. Hemalatha (Johns Hopkins Univ., Baltimore).

Complications in measurements of chromosomal radiosensitivity are discussed. Research on this topic is described which falls into three classes: ultraviolet-x ray combination studies, infrared-x ray combination studies, and interaction of broken chromosomes. (D.L.C.)

7410 (BNL-675(p.62-75)) FACTORS CONTROLLING THE RADIOSENSITIVITY OF YEAST CELLS. Robert K. Mortimer (California. Univ., Berkeley. Donner Lab. and California. Univ., Berkeley. Div. of Medical Physics).

Studies on the radiosensitivity of yeast cells are reviewed with emphasis on the types of damage leading to lethal damage. The relation of radioresistance to cell ploidy is discussed. (D.L.C.)

7411 (BNL-675(p.76-100)) NUCLEAR FACTORS AFFECTING RADIOSENSITIVITY. I. THE INFLUENCE OF NUCLEAR SIZE AND STRUCTURE, CHROMOSOME COMPLEMENT, AND DNA CONTENT. Arnold H. Sparrow and H. J. Evans (Brookhaven National Lab., Upton, N. Y.).

Acute or chronic irradiation of a large number of higher plant species was carried out and the following responses studied: chromosome breakage, somatic mutation, growth inhibition, and lethality. The roles of certain nuclear variables in determining the radiosensitivity were analyzed and it is concluded that: (1) Chromosome breakage reaches a maximum after a few days and then levels off except for growth-inhibiting doses. (2) The frequency of chromosome deletions per r of chronic irradiation is higher for slow than for fast growth. (3) Larger nuclear volumes result in greater sensitivity. (4) The frequency of chromosome aberrations per r of daily exposure is dependent on nuclear volume. (5) Somatic mutations (flower color) are also related to nuclear size. (6) DNA content and nuclear volume are highly correlated. (7) In polyploid species, the average protective effect of doubling the chromosome number is 1.67, and polyploidy has a protective effect in higher plants. (8) Nuclear volume divided by chromosome number may be a better index of radiosensitivity than nuclear volume alone. (9) A nearly constant number of ionizations per nucleus is required to produce growth inhibition or death, but the number of ionizations per DNA molecule depends on the nuclear volume and chromosome number. (10) Extrapolation of certain kinds of radiobiological data from one plant species to another can be made if nuclear volumes and chromosome numbers are known and radiation exposure conditions specified. (D.L.C.)

7412 (BNL-675(p.101-27)) NUCLEAR FACTORS AFFECTING RADIOSENSITIVITY. II. DEPENDENCE ON NUCLEAR AND CHROMOSOME STRUCTURE AND ORGANIZATION. H. J. Evans and A. H. Sparrow (Brookhaven National Lab., Upton, N. Y.).

The importance of such factors as nuclear geometry, nucleoli, heterochromatin, chromosome number, and centromeres is discussed in relation to chromosome breakage and radiosensitivity. A study was made of the relation between chromosome aberration frequency and growth inhibition under chronic gamma irradiation for three plant species, Luzula purpurea (2n = 6), Vicia faba (2n = 12), and Lilium longiflorum (2n = 24). The principal findings are summarized as follows: The frequency of micronuclei at a given chronic dose rate is directly dependent on the dose accumulated by the cells in one complete mitotic cycle and in Vicia and Lilium increases exponentially with dose rate. Growth stimulation may occur at low dose rates, but at higher dose rates the net growth decreases exponentially. Vicia and Lilium are almost equally radiosensitive (45 r/day for growth inhibition), indicating that the higher chromosome number in Lilium offsets the effects of its larger nucleus and higher chromosome breaking frequency. In Luzula, chromosome fragments are rarely lost from the nucleus. Thus, the fact that Luzula is ~11 times more radioresistant (500 r/day for growth inhibition) than Vicia or Lilium is in accord with the hypothesis that growth inhibition is due to genetic loss from exclusion of chromosome fragments at mitosis. (D.L.C.)

7413 (BNL-675(p.128-57)) CONTROL OF FACTORS AFFECTING THE RESPONSE OF PLANTS TO MUTAGENS. C. F. Konzak, R. A. Nilan, J. R. Harle, and R. E. Heiner (Washington State Univ., Pullman).

The properties of seeds which are desirable for studies with mutagens and the measures of damage induced in barley seeds are outlined. Experimental results of radiation and chemical mutagen (diethyl sulfate) studies on barley seeds are given. The factors affecting mutagen sensitivity are outlined. (D.L.C.)

7414 (BNL-675(p.158-75)) SENSITIVITY OF MAMMALIAN TISSUES TO CONTINUOUS EXPOSURE. L. F. Lamerton, G. G. Steel, and Doris R. Wimber (London. Royal Cancer Hospital. Inst. of Cancer Research).

Experiments are described in which rats were continuously irradiated at dose rates from 415 to 4 rad/day and the response of certain tissues studied, particularly the epithelium of the small intestine and the bone marrow. Stress studies on the ability of the irradiated rats to recover from bleeding were also carried out. Possible mechanisms to account for differences in the responses of the various tissues are discussed. (D.L.C.)

7415 (BNL-675(p.176-99)) RADIOSENSITIVITIES OF NERVOUS TISSUES. Wolfgang Zeman (Indiana Univ., Indianapolis. School of Medicine).

A review of radiosensitivities of nervous tissue is presented with reference to physiologic, psychologic, and pathomorphologic responses. The high sensitivity of receptor cells is linked to the basic principle of nervous function, namely, the rapid change of membrane perme-

ability due to radiochemically produced changes in the configuration of protein molecules. A high capacity of the nerve cell for protein synthesis is considered to account for its high tolerance for pathomorphologic responses. Absence of lysosomal enzymes and of nucleic acids in nerve fibers appears to make these structures extremely tolerant, whereas their metabolic dependency upon oligodendrocytes renders them sensitive in delayed radionecrosis. Regional differences in sensitivity correlate to some extent with local differences in oxygen pressure and thus may depend on the oxygen effect. In other instances, selectivity for direct cell injury could be a function of the ratio of nuclear volume to unit tissue volume. It is suggested that the extremely low rate of the molting turnover of neural interstitial elements provides a satisfactory explanation of the latencies for delayed necrosis. (D.L.C.)

7416 (BNL-675(p.200-3)) DELAYED EFFECTS OF LOCALIZED X-IRRADIATION OF THE NERVOUS SYSTEM OF EXPERIMENTAL RATS AND MONKEYS. J. R. M. Innes and A. Carsten (Brookhaven National Lab., Upton, N. Y.). (BNL-5558)

The results of experiments on the localized x irradiation of various parts of the spinal cord, brain, and peripheral nerves of rats and monkeys are summarized. Latent periods of 3 to 9 months were observed. (D.L.C.)

7417 (BNL-675(p.204-19)) THE OXYGEN EFFECT IN MAMMALS. R. H. Thomlinson (Gt. Brit. Medical Research Council. Experimental Radiopathology Research Unit, Hammersmith Hospital, London).

The oxygen effect in the irradiation of mammals is discussed with respect to its possible exploitation in the treatment of human cancer. Research in this field suggests that normal tissue, except cartilage and bone, is near its maximal sensitivity when the animal is breathing air. Experiments are reported in which the effects of irradiation on tumor growth in rats were studied under air, anoxic, and oxygen (45 psi) conditions. The fibrosarcoma R.I.B.5 tumors were found to be protected from radiation injury by diminshed oxygen tensions, and the mechanism of diminished oxygen tension or anoxia is discussed. It is postulated that a shrinking tumor is favorable for treatment. A group discussion is included. (D.L.C.)

7418 (BNL-675(p.220-45)) RADIATION RESPONSES OF MAMMALIAN CELLS. M. M. Elkind (National Cancer Inst., Bethesda, Md.).

Experimental work on cultured mammalian cells with quantitative single-cell techniques is reviewed. A limited number of in vitro and in vivo experiments are compared, and the in vitro observations are used to develop a tentative model for whole-body irradiation of animals. The model gives predictions which are in qualitative agreement with observations. A group discussion is included. (D.L.C.)

7419 (BNL-675(p.246-61)) MIGRATING CELLS IN THE DEVELOPING NERVOUS SYSTEM STUDIED BY THEIR RADIOSENSITIVITY AND TRITIATED THYMIDINE UPTAKE. Samuel P. Hicks, Constance J. D'Amato, Marie A. Coy, Elaine D. O'Brien, Jean M. Thurston, and David L. Joftes (New England Deaconess Hospital. Cancer Research Inst., Boston and Harvard Univ., Boston. Medical School).

Studies of rat embryos are described in which the changing positions of 200-r-sensitive cells and cells labeled with tritiated thymidine in the nervous systems were followed. The pathways of migration and other movements of these cells were mapped. A time delay was found in the movement of proliferated cells to the cortex. A group discussion is included. (D.L.C.)

7420 (BNL-675(p.262-86)) RADIOSENSITIVITY OF THE DEVELOPING PLANT EMBRYO. L. W. Mericle and R. P. Mericle (Brookhaven National Lab., Upton, N. Y.). (BNL-5562)

A study was carried out on the radiosensitivity of barley embryos in various stages of development. The dose-rate responses and patterns of stage sensitivity are discussed. The developmental factors modifying radiosensitivity are discussed. (D.L.C.)

7421 (HW-SA-2365) PRELIMINARY OBSERVATIONS ON THE BIOLOGICAL EFFECTS OF Sr^{90} IN MINIATURE SWINE. R. O. McClellan, W. J. Clarke, N. L. Dockum, V. G. Horstman, J. R. McKenney, G. S. Vogt, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [1961]. Contract AT(45-1)-1350. 13p.

A study was begun in 1958 on the effects of 1 to 25 μc Sr^{90}/day feedings on Pitman-Moor miniature swine. Three generations are now in hand, and blood examinations give no evidence of significant changes; it is emphasized that only 2.5 years have elapsed during this study and that critical effects may not be seen for several years. (D.L.C.)

7422 (ORO-503) THE EFFECTS OF ULTRAVIOLET LIGHT AND GAMMA RAYS ON CELL LIPIDS AND THE PHYSIOLOGICAL ACTION OF IRRADIATED LIPIDS. Progress Report, September 1, 1960 to August 15, 1961. Karl M. Wilbur and Frederick Bernheim (Duke Univ., Durham, N. C.). Contract AT-(40-1)-1647. 15p.

A brief summary is given of studies on the effects of whole-body x irradiation with 800 r on enzyme activity of the intestinal mucosa in rats, and the effects of γ radiation on protein synthesis as measured by the incorporation of labeled amino acids into proteins of the yeast, Schizosaccharomyces pombe. (C.H.)

7423 (TID-14567) COMPARATIVE STUDIES OF THE EFFECT OF X-IRRADIATION ON PROTOZOA AND MAMMALS. Progress Report, March 1, 1961–December 1, 1961. Jay S. Roth (Connecticut. Univ., Storrs). Contract AT(30-1)-2337. 33p.

Progress is reported in studies on the biochemistry of irradiated protozoa. Tetrahymena pyriformis were shown to contain considerable catalase activity, 90% of which was found associated with the particulate fractions. Data are included from studies on the properties of Tetrahymena catalase, the effects of catalase inhibitors on growth and respiration of Tetrahymena, and the effect of P^{32} in the growth medium on growth of Tetrahymena. Progress is also reported in studies on the effect of whole-body x irradiation on lysomal enzymes in rat spleen and liver. A new technique for the determination of nucleotide deaminase activity was developed and applied to the assay of tissues from normal and tumor-bearing rats. Results are included from preliminary studies on the effect of x radiation on deaminase activity in rat liver. (C.H.)

7424 (TID-14691) STUDIES ON PHOTOREACTIVATION IN VITRO. Progress Report. William D. Fisher (New York. State Univ., Syracuse. Upstate Medical Center). [1961]. Contract AT(30-1)-2535. 10p.

The effect of u-v light on the incorporation of C^{14}-labeled amino acids into proteins by isolated calf thymus nuclei was determined for lysine, leucine, alanine, glycine, and phenylalanine. The resulting composite dose curve with a 37% inactivation dose of ~3000 erg/mm^2 suggests a common site of action or multiple sites with identical u-v sensitivity. The effect of DNAase (which stops protein synthesis) on the u-v inactivation of phenylalanine incorporation into nuclear proteins of thymus nuclei was also

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studied; the negative results indicate that DNA is not involved in the inactivation. The effect of u-v on C^{14}-labeled orotic acid and adenine incorporation in thymus nuclei was also determined. (D.L.C.)

7425 (JPRS-11730) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, 6: No. 6, 3-94 (June 1961). 157p.

Abstracts of papers contained in this journal appear in Nuclear Science Abstracts Vol. 15, No. 22. (C.H.)

7426 AUTOGENOUS RECOVERY OF MARROW FUNCTION. Recovery After General Exposure to 1082 Roentgens of Co^{60} Radiation at 36 Roentgens Per Hour. E. Donnall Thomas (Mary Imogene Bassett Hospital, Cooperstown, N. Y.), Emery C. Herman, Joe H. Cannon, Otto D. Sahler, Joseph W. Ferrebee, H. E. M. Kay, and M. Constantoulakis. A.M.A. Arch. Internal Med., 107: 395-400(Mar. 1961).

The case of an infant with acute leukemia following a tissue dose of 864 r of whole-body irradiation, midline air dose 1082 roentgens (36 r per hr), is described. The patient was kept in good clinical condition by isolation, supportive therapy, antibiotics, and platelet transfusions. Multiple infusions of fetal hematopoietic tissue and one infusion of adult marrow were given without evidence of a successful marrow transplant. Autogenous marrow recovery occurred after 29 days. There was a remission of the leukemia lasting for 3 months. Significant features of the case are discussed, particularly the evidence that after exposures of 300 to 1000 r a regeneration of marrow may be expected provided the patient is kept in good general condition. (auth)

7427 STUDIES ON INDUCED VARIATION IN THE RHIZOBIA. II. RADIATION SENSITIVITY AND INDUCTION OF ANTIBIOTIC-RESISTANCE MARKERS. E. A. Schwinghamer and R. L. Dalmas (Brookhaven National Lab., Upton, N. Y.). Appl. Microbiol., 9: 410-14(Sept. 1961). (BNL-5107)

The relation between survival and dose of ultraviolet (uv) light or x rays was, with only one exception, nonlinear for late-log-phase cultures of four species of Rhizobium. The LD_{90} for different bacterial strains ranged from 400 to 3,000 ergs per mm^2 for uv treatment, and from 3.0 to 7.5 kr for x-ray treatment. Minor existing differences in response to some antibacterial compounds (disc tests) were usable as secondary markers for genetic experiments. Spontaneous and radiation-induced mutants, resistant to high levels of several antibiotics, notably dihydrostreptomycin and erythromycin, were isolated for primary marker purposes. A significant phenotypic lag for mutation to dihydrostreptomycin resistance was noted for uv-irradiated cells. The uv-induced frequency exceeded the x-ray-induced frequency by a factor of at least three, at a comparable level of lethality. No significant change in the symbiotic capability was observed in rhizobial strains marked with antibiotics resistance. (auth)

7428 INCREASING THE RADIOSENSITIVITY OF TUMOURS BY COMBINED ACTION OF "DICETOL" AND RADIATION. Kumudini N. Gadekar and M. B. Sahasrabudhe (Indian Cancer Research Center, Bombay and Atomic Energy Establishment, Trombay, India). Brit. J. Cancer, 15: 489-97(Sept. 1961).

A method to render radiosensitive all the cancer cells in the tumor mass is presented. Radiation sensitivity of tumors was shown to be augmented by pretreatment with dicetol. Since dicetol is non-toxic in therapeutic doses it is suggested that combined treatment with dicetol and radiation may help in increasing the therapeutic effectiveness of radiation therapy in the treatment of malignant diseases. (auth)

7429 THE AGE FACTOR IN THE SUSCEPTIBILITY OF MAN AND ANIMALS TO RADIATION. I. THE AGE FACTOR IN RADIATION SENSITIVITY IN MICE. Patricia J. Lindop and J. Rotblat (St. Bartholomew's Hospital, London). Brit. J. Radiol., 35: 23-31(Jan. 1962).

The variation with age of the sensitivity both for acute and long term effects of radiation in mice is discussed. The experiments on acute effects show that while in the adult period the sensitivity remains constant to within 10%, there are two age periods when there is a large variation of sensitivity. In the young mice there is a sharp peak, giving about 40% increase in sensitivity at the age of four weeks. In old age there is a steady increase, making old mice about twice as sensitive as in the adult period. The increase in sensitivity of the old mice is roughly proportional to their remaining life expectation. Sex was found to have a slight effect. After studying the long-term effects, it was found that the amount of life-shortening is markedly dependent on the age at irradiation; the same dose of radiation results in different reductions of the life-span, depending on the age at which the animals were exposed. The causes of death, and the influence of age on acute and long term effects of radiation in relation to the protection offered by hypoxia are also discussed. (P.C.H.)

7430 THE AGE FACTOR IN THE SUSCEPTIBILITY OF MAN AND ANIMALS TO RADIATION. II. AGE DIFFERENCES IN SUSCEPTIBILITY TO CARCINOGENESIS IN MAN. Richard Doll (London School of Hygiene and Tropical Medicine). Brit. J. Radiol., 35: 31-6(Jan. 1962).

The relation between cancer incidence, and age and susceptibility to cancer induction at different ages are discussed. It is tentatively suggested that the susceptibility to cancer induction in man does vary with age, and that this variation is dependent upon a number of different and sometimes conflicting factors. The variation is determined in part by the activity of the tissue, which is important in the case of the thyroid, and in part by the past exposure of the specific tissue to other factors which determine the normal incidence of cancer at different ages. Susceptibility to cancer induction will not be expected to alter with age unless there is evidence that the normal incidence of cancer in that tissue also alters with age, but when the normal incidence increases rapidly, susceptibility to cancer induction by any individual agent is expected to increase. (P.C.H.)

7431 THE AGE FACTOR IN THE SUSCEPTIBILITY OF MAN AND ANIMALS TO RADIATION. III. THE AGE OF THE PATIENT AND TOLERANCE TO RADIATION. Robert C. Tudway (Bristol Royal Hospital, Eng.). Brit. J. Radiol., 35: 36-42(Jan. 1962).

An attempt is made to demonstrate the decrease of tolerance to radiation with age by studying the radiotherapy of skin tumors. The age distribution of treatments which resulted in radionecrosis is compared with the age distribution of all radiotherapy of skin tumors. A diagram of the age incidence of radiotherapy of skin tumors shows that there is a maximum at over 70 years. In the age incidence of treatments which produced radionecrosis the maximum occurs at 60 to 70 years. After the age of 70 there is a deliberate reduction in radiation dosage in radical therapy and frequent use of smaller palliative doses. It is suggested that the dosage reduction be 5% from 50 to 60 years, 10% from 60 to 70 years, and 20% over 70, compared with the doses used for adults aged 40. For children, a reduction of

about 20% below the age of 12, and 10% from 12 to 15 is suggested, provided that correction is made for equality of areas relative to the size of the patient. (P.C.H.)

7432 MECHANISMS OF REORGANIZATION AND CELL REPOPULATION IN MERISTEMS IN ROOTS OF VICIA FABA FOLLOWING IRRADIATION AND COLCHICINE. D. Davidson (Oak Ridge National Lab., Tenn.). Chromosoma, 12: 484-504(1961). (In English)

The treatment of Vicia roots with 600 r, 300 r plus colchicine, or colchicine alone resulted in a complete, though temporary, inhibition of root growth. Mitoses were seen 2 to 10 days after x irradiation or colchicine treatment. This indicates that cell division does occur in roots whose growth in length has been temporarily inhibited. It is estimated, from the relative frequencies of cells with atypical chromosome complements, that the primordium is composed of 40 to 50 cells. The roots were found to recover from the effects of colchicine in about 10 days. In the first part of the period, polyploid cells were frequent in the meristem but they later decreased in frequency. In lateral roots developing from the C-tumor, polyploid cells were still present in high frequency at a time when they were infrequent in the primary root. It is suggested that the size of the primordium is important for regeneration; the new growth is attributed to the stimulation of elongation in cells basal to the primordium by auxin secreted by the cells of the primordium. It is further suggested that the apical cells of the growing root also synthesize growth simulants. The data support several hypotheses. (P.C.H.)

7433 THE PERSISTENCE OF CHROMOSOMAL INJURIES IN SOMATIC CELLS OF RAT LIVER AFTER IRRADIATION WITH X-RAYS. I. M. Shapiro (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 734-6(Nov. 21, 1961). (In Russian)

White rats of both sexes were irradiated with a total x-ray dose of 92 r. The control group was not irradiated but was subjected to a hepatectomy. Series I was operated on 30 days after the irradiation and series II was operated on 24 days after irradiation. Series III was irradiated 10 to 20 minutes after the hepatectomy. Series IV was irradiated 6 hours after the hepatectomy. All the rats were killed by decapitation within 30 hours after the operation. A liver section was fixed with Zenker's solution, and the chromosomal aberrations were counted. The number of damaged cells was found to be about 22% in each case. The number of chromosomal aberrations did not vary for a period of 1 to 30 days after the irradiation. It is possible that this persistence of non-lethal damaged chromosomes in the irradiated cells can lead to the occurrence of cancerous growths. (TTT)

7434 COMPARISON OF EFFECTS OF ATOM DECAY AND BETA-RAY RADIATIONS ON THE INACTIVATION AND MUTATION OF A MYCOBACTERIUM. Michio Tsukamura (Obuso National Sanatarium, Obu, Japan). Genetics, 46: 1561-4(Dec. 1961).

The effects of P^{32} and Sr^{90} added to culture media were compared in a Mycobacterium to determine whether decay of atoms or intracellular beta radiations takes an important role in causing inactivation and mutation. Both inactivation and mutation occurred significantly in a culture grown in medium containing 1 μc P^{32}/ml, and only a moderate increase of mutations occurred without inactivation of cells in a culture grown in medium containing 20 μc Sr^{90}/ml. No significant increase of mutation was seen in a culture grown in medium containing 2 μc Sr^{90}/ml. Since large amounts of intracellular and extracellular beta radiations from Sr^{90} were found to be ineffective in causing inactivation of cells and much less effective in causing mutation than is true for a small amount of P^{32}, it is conceivable that inactivation and mutations occurring in cells grown in medium containing such a small amount of P^{32} (1 μc P^{32}/ml) are due neither to intracellular nor extracellular beta-ray radiations but mostly to decay of P^{32} atoms incorporated into cells. (auth)

7435 THE INFLUENCE OF GENETIC BACKGROUND ON THE FREQUENCY AND THE DIRECTION OF RADIATION-INDUCED MUTATIONS AFFECTING A QUANTITATIVE CHARACTER. Ilse Mueller and Allen P. James (Atomic Energy of Canada Ltd., Chalk River, Ont.). Genetics, 46: 1721-33(Dec. 1961).

Background on the phenotypic effects of a random sample of radioinduced mutations affecting a quantitative character was studied. The character was the rate of cell division in Saccharomyces cerevisiae. Three diploid strains of yeast which differed in rate of cell division and in degree of heterozygosity were utilized. The distributions of growth rates of clones produced by single-cell isolates of the irradiated populations were compared with those for unirradiated control samples. No two of the strains reacted alike. Mutations were completely ineffective in the most homozygous and least adapted strain, mainly negative in the intermediate strain, and mainly positive in the most heterozygous and fastest growing strain. It was concluded that vagaries in the influence of different genetic constitutions on the expressions of the mutant genes are stronger than was originally supposed. The importance of epistasis in quantitative inheritance is emphasized. (auth)

7436 AGE-RELATED CHANGES IN ERYTHROCYTE AGGLUTINABILITY IN HIROSHIMA SUBJECTS. J. W. Hollingsworth, H. B. Hamilton, and G. Ishii (Atomic Bomb Casualty Commission, Hiroshima and Nagasaki). J. Appl. Physiol., 16: 1093-6(Nov. 1961).

As part of a physiologic aging assessment in survivors of the atomic bombing, agglutinability of erythrocytes with A and B antisera was studied in 1495 subjects in Hiroshima. It was found that erythrocyte agglutinability is maximal during the third decade and falls progressively with advancing years. At age 20-40, agglutinability of erythrocytes from females was somewhat less than that of males. Subjects of blood group AB demonstrated agglutinability titers with both antisera comparable to the titers of the group A and B subjects. Analysis of agglutinability titers in relationship to degree of irradiation from the Hiroshima atomic bomb in 1945 failed to show differences, but the sample was too small to allow definite conclusions about possible radiation-accelerated aging. (auth)

7437 SYMPOSIUM ON RECOVERY OF CELLS FROM INJURY, GIVEN AT RESEARCH CONFERENCE FOR BIOLOGY AND MEDICINE OF THE ATOMIC ENERGY COMMISSION, HELD AT GATLINBURG, TENNESSEE, APRIL 3-6, 1961. J. Cellular Comp. Physiol., 58: Suppl. 1, (Dec. 1961). 253p.

Separate abstracts have been prepared for the 21 papers presented at this symposium. (C.H.)

7438 MODIFICATION OF RADIATION-INDUCED ELECTRON SPIN RESONANCES IN DRY MATERIALS. J. S. Kirby-Smith and M. L. Randolph (Oak Ridge National Lab., Tenn.). J. Cellular Comp. Physiol., 58: Suppl. 1, 1-11(Dec. 1961).

The modification of spin resonances in pure condensed chemical systems and dry or semi-dry biological materials follow identical or closely parallel mechanisms. Thus, we

may expect further studies of radiation-induced radicals in chemical or biochemical systems, studies which in themselves are a fascinating branch of radiation chemistry and solid state physics, to be of continued application to the radiobiology of semi-dry organisms. Looking toward the future role of ESR, the extension of this approach to radiation studies in wet, typically metabolizing systems holds great promise. Improved techniques now permit studies of enzyme mechanisms to be made, and there is good reason to believe that the kinetics of shorter-lived radiation-induced resonances in wet, typically metabolizing living materials can ultimately be elucidated by ESR methods. (auth)

7439 REVERSIBILITY OF X IRRADIATION-INDUCED EFFECTS IN DRY BIOLOGICAL SYSTEMS. E. L. Powers (Argonne National Lab., Ill.). J. Cellular Comp. Physiol., 58: Suppl. 1, 13-25(Dec. 1961).

The dry bacterial spore has revealed that there are many ways in which this cell responds to radiation. Even the single biological effect measured here is accomplished in a number of different ways. The fast, oxygen-independent portion can be subdivided into two effects. The fast oxygen-dependent portion appears at the present time to be a single entity, and the long-lived free radical class may be divisible into three different subunits, a possible total of 6 currently recognized components of radiation-induced effects that precede and lead to biological damage. It has been revealed also that some of these elements may act independently and behave differently under different circumstances, and thus contribute to the biological effect to different degrees at various times. Fortunately one can isolate them to measure their independent behaviors, thus allowing the study of their interactions with one another when they act at the same time. It is shown that with the knowledge of the independent behavior of the components of radiation damage, one can explain the response of a population of cells in which the biological effect is the result of the actions of all. (auth)

7440 BIOLOGICAL AFTER-EFFECT AND LONG-LIVED FREE RADICALS IN IRRADIATED SEEDS. Alan D. Conger (Univ. of Florida, Gainesville). J. Cellular Comp. Physiol., 58: Suppl. 1, 27-32(Dec. 1961).

Biological damage in irradiated barley seeds was measured as damage to seedling growth, survival of the seed to a mature plant, chromosomal aberrations, or mutation. The various damages were found to be related. It is postulated that the biological after-effect in irradiated dry seeds is due to decay of the long-lived free radicals, derived from radicals initially generated by the radiation, and persisting after the irradiation is over. Results are reported from studies on the effects of various treatments, such as water, oxygen, other gases, and temperature, on post-irradiation free radicals and on the after-effect phenomena in irradiated barley seed. (C.H.)

7441 THE EFFECTS OF ULTRAVIOLET LIGHT ON THE BIOLOGICAL AND PHYSICAL CHEMICAL PROPERTIES OF DEOXYRIBONUCLEIC ACIDS. J. Marmur, W. F. Anderson, L. Matthews, K. Berns, E. Gajewska, D. Lane, and P. Doty (Harvard Univ., Cambridge, Mass.). J. Cellular Comp. Physiol., 58: Suppl. 1, 33-55(Dec. 1961).

When DNA is irradiated in solution with UV light at 254 mμ, loss of transforming activity and changes in the physical chemical properties of the DNA can be detected. The loss of biological activity, studied with DNA isolated from D. pneumoniae and B. subtilis, depends on the genetic marker under investigation as well as on its size and on the molecular weight of the DNA being irradiated. When exposed to higher dose levels, native DNA is both partially degraded and weakened in structure. Cross-linking of the complementary strands has been detected. The UV induced physical chemical alterations have been detected by the lowering of the denaturation temperature, a drop in sedimentation coefficient after denaturation, a decrease in viscosity, an increase in buoyant density in a CsCl gradient, a cross-linking of DNA strands and an increase in the pH at which the molecules denature. Most of the physical chemical changes are accentuated by a higher adenine plus thymine content of the DNA and by the substitution of 5-bromouracil for thymine. Denatured and native DNA behave differently when exposed to the same dose at the same wavelength. As in the biological experiments, for the same dose levels, the smaller the molecular weight of the DNA, the less the physical chemical damage. Both the biological and the viscosity changes induced by UV show no oxygen effect. The photoreactivating enzyme from bakers' yeast reactivates UV-treated transforming DNA in the presence of visible light; the reactivation might be due in part to the disruption of the cross-links induced by UV. (auth)

7442 REPAIR OF ULTRAVIOLET DAMAGE IN CELLULAR DNA. Claud S. Rupert (Johns Hopkins Univ., Baltimore). J. Cellular Comp. Physiol., 58: Suppl. 1, 57-68(Dec. 1961).

Something happens to the UV damage of cellular DNA during photoreactivation of cells so that it can no longer be detected in cell lysates. The disappearance is consistent with its repair, although in the absence of a recognized biological activity for the extracted DNA, it cannot be certain that this material has returned to its original state. The DNA damage repairable by the photoreactivating enzyme in vitro is produced by short wave lengths of natural sunlight, and can be repaired by this enzyme at the same time it is being produced, utilizing the longer wave lengths of sunlight to drive the reaction. From circumstantial evidence it is surmised that photoreactivable UV lesions in DNA cause a significant fraction of the total effects of UV on cells. Their repair is essential if these effects are to be prevented. These lesions therefore correspond to the radiation-induced poison sometimes invoked to account for UV phenomena in organisms. Photoreactivation is one of the mechanisms evolved by cells to repair the damage produced by sunlight in their DNA. Because it is so widespread among living things and because it could in principle occur with such a low level of cellular organization it could be considered a primitive mechanism, evolving fairly early in the history of life on earth. Other more sophisticated mechanisms probably exist to perform the same function and may be responsible for some of the factors modifying the effects of UV radiation on cells. (auth)

7443 GENE-CONTROLLED REACTIVATION OF ULTRAVIOLET-INACTIVATED BACTERIOPHAGE. Walter Harm (Universität, Cologne). J. Cellular Comp. Physiol., 58: Suppl. 1, 69-77(Dec. 1961).

Results are reported from studies on the reactivation of ultraviolet-inactivated bacteriophage which indicate a difference in ultraviolet sensitivity between the closely related phages T2 and T4. For any given survival level, T4 was found to need about twice the ultraviolet dose as T2, although these two phages contain approximately equal amounts of desoxyribonucleic acid and do not differ noticeably in their sensitivities to x rays or incorporated P^{32}. Possible mechanisms involved in gene-controlled reactivation are discussed. (C.H.)

7444 THE ANALYSIS OF ULTRAVIOLET LESIONS IN BACTERIOPHAGE T4 BY CROSS REACTIVATION. A. H.

Doermann (Vanderbilt Univ., Nashville). J. Cellular Comp. Physiol., 58: Suppl. 1, 79-93(Dec. 1961).

The cross-reactivation procedure is described. Applications in the analysis of ultra-violet induced lesions in bacteriophage T4 are discussed. From single burst experiments it is clear that UV makes lesions in the genome and that markers are knocked out in a correlated way or independently of each other, depending on the closeness of their genetic linkage. This suggests that the total UV target includes an appreciable fraction which suffers discrete genetic damages, and that markers are rescued by genetic recombination. A final conclusion is that UV-damaged genomes do not multiply, or multiply only to a very limited extent. (C.H.)

7445 FACTORS INFLUENCING THE SURVIVAL OF BACTERIA AFTER EXPOSURE TO IONIZING RADIATION. Howard I. Adler and Manfred S. Engel (Oak Ridge National Lab., Tenn.). J. Cellular Comp. Physiol., 58: Suppl. 1, 95-105(Dec. 1961).

Results are reported from a series of studies on the effects of preirradiation growth in the presence of glucose or under anaerobic conditions on the radiation resistance of cells of E. coli B/r. The effect of pH of the growth media, desoxyribonucleic acid content, ribonucleic acid content, postirradiation plating effects, basic media, hydrogen peroxide anaerobic growth conditions, catalase or cytochrome activity, and other variables are discussed. It is concluded that growth in glucose favors the synthesis of a protective system or a recovery system. The system may be a single compound acting as a chemical protective agent or a more complex enzyme system that allows the cell to repair or bypass radiation-caused damage. In any case, the synthesis of the system involves only anaerobic steps in the dissimilation of glucose since it can develop in anaerobically grown cells. (C.H.)

7446 DO X RAYS PRODUCE CHROMOSOME BREAKAGE IN ESCHERICHIA COLI K-12? Herbert Marcovich (Institut Pasteur, Paris). J. Cellular Comp. Physiol., 58: Suppl. 1, 107-12(Dec. 1961).

Escherichia coli K-12 HfrH cells were irradiated with increasing doses of x rays. The frequency of the selected markers in the recombinants after mating with an F− strain (PA 309) decreased exponentially as a function of dose. The sensitivity of the process is proportional to the distance of the locus of the marker from the origin "O" of the chromosome. The same finding is obtained when nonselected markers are concerned. In this case, the distance to be considered is the one to the nearest selected marker. The radiosensitivity of the chromosome appears to be homogeneous in the "O"−Histidine region. Quantitative implications, based on the absence of translocations in the recombinants between F− cells and survivors of irradiated HfrH cells yield to the conclusion that x irradiation may produce points of frailty on the bacterial chromosome that may result in true breaks during conjugation. Aside from the damage to the transfer mechanism of the markers x rays seem to induce a genetic change that lowers the probability for the markers to be injected into the zygote. (auth)

7447 POSTIRRADIATION SURVIVAL KINETICS OF MAMMALIAN CELLS GROWN IN CULTURE. M. M. Elkind, Harriet Sutton, and Willie B. Moses (National Cancer Inst., Bethesda, Md.). J. Cellular Comp. Physiol., 58: Suppl. 1, 113-34(Dec. 1961).

In connection with the question of lethal sites in a cell, results are reported from studies on the kinetics of cells surviving an initial x-ray exposure. Two cell lines derived from the Chinese hamster and grown in tissue culture were used in the studies. Possible reaction mechanisms involved are discussed. A genome hypothesis of radiation injury, based upon a target-theory model which precludes significant interactions between desoxyribonucleic acid structures and other parts of the cell, is compared with an interpretation which does not rule out a target-type of model providing that the number and/or sensitivity of the targets is dependent upon the age of a cell with respect to its interdivisional cycle. (C.H.)

7448 MODIFICATION OF MUTAGENESIS INITIATED BY ULTRAVIOLET LIGHT THROUGH POSTTREATMENT OF BACTERIA WITH BASIC DYES. Evelyn M. Witkin (State Univ. of New York, Brooklyn). J. Cellular Comp. Physiol., 58: Suppl. 1, 135-44(Dec. 1961).

Posttreatment with basic dyes, in concentrations that retard cell division, was found to influence the induction of mutations to prototrophy by UV light in a tyrosine-requiring strain of E. Coli. Pyronin, which is unique among the dyes in its selective affinity for RNA, was found to duplicate the effects of chloramphenicol or amino acid deprivation in causing the rapid and irreversible loss of potential prototrophs (mutation frequency decline, or MFD). Acriflavine, methyl green, crystal violet, methylene blue, and toluidine blue, all of which are known to combine with DNA, delay or retard the occurrence of MFD under conditions of amino acid deprivation. When acriflavine is removed from its combination with cellular components by the addition of an excess of sodium deoxyribonucleate, MFD begins promptly. The same basic dyes that delay MFD were also found to interfere with the fixation of mutations (MF) in an amino acid-enriched medium, and to cause marked enhancement of the mutagenic potency of low doses of UV light. While showing no independent mutagenic activity for unirradiated bacteria, all the dyes except pyronin increased the yield of induced mutations significantly when added to the enriched medium upon which irradiated bacteria were incubated. These results were interpreted as evidence that UV light initiates mutagenesis by producing unstable changes directly in genic DNA. MFD is interpreted as a repair process, blocked by the machinery of RNA and protein synthesis and by the presence of certain basic dyes. (auth)

7449 NUCLEIC ACID FORMATION AND ULTRAVIOLET LIGHT-INDUCED MUTATION IN BACTERIA: SOME CONSIDERATIONS IN LIGHT OF RECENT ADVANCES. C. O. Doudney (Univ. of Texas, Houston). J. Cellular Comp. Physiol., 58: Suppl. 1, 145-50(Dec. 1961).

Results are reported from a series of studies on the effect on mutation induction and desoxyribonucleic acid synthesis in Escherichia coli of ultraviolet light and certain analogs which may be incorporated into ribonucleic acid to interfere with macromolecular function. The effects of 5-hydroxyuridine on reactions induced by ultraviolet light are presented in detail. Possible mechanisms involved in desoxyribonucleic acid replication are discussed. (C.H.)

7450 SOME POSTIRRADIATION PHENOMENA THAT AFFECT THE INDUCTION OF CHROMOSOME ABERRATIONS. Sheldon Wolff (Oak Ridge National Lab., Tenn.). J. Cellular Comp. Physiol., 58: Suppl. 1, 151-62(Dec. 1961).

Results are reviewed from studies on the induction of chromosome aberrations and restitutional repair in Tradescantia following exposure to x radiation and neutrons. Results of both biological and biochemical experiments indicate that the production of chromosomal aberrations is not necessarily fixed at the moment of irradiation, but that a repair mechanism operates in the postirradiation

period. This repair mechanism is dependent upon cellular metabolism, energy production, and probably protein synthesis. Biophysical calculations in regard to the distribution of aberrations per cell and the number of primary breaks per cell led to the conclusion that it is a very efficient process with more than 99% of the primary breaks being repaired. This repair process is manifested as chromosome-break rejoining occurs throughout the cell cycle. Stage sensitivity of chromosomes can be accounted for in terms of this repair mechanism and the different spatial relations of the chromosomes and chromatids during the various stages of cell division. (C.H.)

7451 POSTIRRADIATION PROCESSES IN THE INDUCTION OF RECESSIVE LETHALS BY IONIZING RADIATION. R. F. Kimball (Oak Ridge National Lab., Tenn.). J. Cellular Comp. Physiol., 58: Suppl. 1, 163-70 (Dec. 1961).

Studies on x-ray induced recessive lethal mutations in Paramecium suggest at least two post-irradiation processes. These include loss of premutational damage by what can best be looked upon as metabolic repair of localized chromosome lesions, and conversion of remaining damage to mutation at the time of DNA synthesis. Little if any mutation can be produced by irradiation of G2 and early prophase, suggesting that repair of chromosome lesions is remarkably efficient during one or both of these periods. (C.H.)

7452 EFFECT OF DOSE AND DOSE RATE ON RADIATION DAMAGE TO MOUSE SPERMATOGONIA AND OOCYTES AS MEASURED BY CELL SURVIVAL. E. F. Oakberg and Evelyn Clark (Oak Ridge National Lab., Tenn.). J. Cellular Comp. Physiol., 58: Suppl. 1, 173-82 (Dec. 1961).

Results are reported from studies on the effect of low doses of whole-body irradiation and of low dose rates on spermatogonia and oocytes of the mouse exposed to x and γ irradiation. Neutron exposures at low doses were used for comparisons of relative biological effectiveness. While some significant differences attributable to dose rate were observed, they were not consistent throughout. Both oocytes and spermatogonia gave multi-hit survival curves. The fact that oocyte survival after chronic irradiation was higher in adult than in young females suggests either less effective elimination of radiation damage, or a higher sensitivity of comparable oocyte stages in young females. (C.H.)

7453 EFFECT OF RADIATION DOSE RATE ON MUTATION IN MICE. W. L. Russell (Oak Ridge National Lab., Tenn.). J. Cellular Comp. Physiol., 58: Suppl. 1, 183-7 (Dec. 1961).

The nature and the role of recovery processes in the dose-rate effects observed in studies on the effect of dose rate on mutation frequency in mice are discussed. Data are reviewed which confirm the reality of a dose-rate effect on mutation frequency and provide additional evidence for the view that the effect is an intracellular one and not a consequence of cell selection. (C.H.)

7454 RECOVERY FROM PERMUTATIONAL DAMAGE OF X IRRADIATION IN DROSOPHILA SPERMATOGENESIS. F. H. Sobels and A. D. Tates (State Univ. of Leiden). J. Cellular Comp. Physiol., 58: Suppl. 1, 189-96 (Dec. 1961).

Data relating to repair processes in Drosophila males are summarized. The data suggest that repair from premutational damage is possible in at least three different stages of spermatogenesis, that is spermatids, meiotic stages, and late spermatogonia. Most data are available for stages characterized by peak sensitivity to x irradiation, presumably consisting of spermatids and late spermatocytes. Here fractionation of the dose and pretreatment with chloramphenicol lower the mutagenic effects of radiation, whereas posttreatment with nitrogen results in an increase of radiation-mutagenicity. Posttreatment with cyanide may result in either an increase or a decrease of the mutation-frequency. As pointed out before, these observations can be explained by assuming that two processes with contrasting effects are involved in repair from premutational damage. The observation that pretreatment with chloramphenicol results in an increase of the radiosensitivity in sperm and in a decrease of that in spermatids may help to understand the pronounced differences in radiosensitivity between these two stages. Recovery seems to occur in dividing cells as meiotic stages and late spermatogonia where the mutagenic effect of radiation is reduced by pretreatment with chloramphenicol and enhanced by anoxia, following radiation. The observation that in dividing germ cells of Drosophila completion of the radiation-initiated mutation process is associated with protein synthesis is in good agreement with the findings in lower organisms like Paramecium and bacteria. Also, it may be pointed out that there is a fair correspondence between the course of spermatogenesis in Drosophila and in the mouse. In the mouse the work of Russell and coworkers gives a clear indication that repair of initial radiation damage in gonia is possible. In view of the present Drosophila data it is tempting to believe that there is a uniform pattern to which repair-processes conform in dividing cells of widely divergent organisms. (auth)

7455 CAN DROSOPHILA SPERMATOZOA BE USED IN STUDIES OF RECOVERY PROCESSES? K. G. Luening (Univ. of Stockholm). J. Cellular Comp. Physiol., 58: Suppl. 1, 197-201 (Dec. 1961).

Results are reported from studies of genetic damage and recovery processes in male Drosophila x irradiated in air or in nitrogen mustard and mated within the first 24-hr. Data are included on the effects of dose fractionation on the induction of point mutations and chromosome breaks. The influence of heterogeneity in sperm available the first day after irradiation on results is discussed. (C.H.)

7456 ON RECOVERY IN X-IRRADIATED GERM CELLS. Irwin I. Oster (Inst. for Cancer Research, Philadelphia). J. Cellular Comp. Physiol., 58: Suppl. 1, 203-7 (Dec. 1961).

Evidence is presented for recovery following x irradiation of mature germ cells of Drosophila. The effects of variations in oxygenation of spermatozoa located in different sections of the reproductive tract and the effects of different types of treatment on the radiosensitivity of spermatozoa are discussed. (C.H.)

7457 BIOCHEMICAL PROCESSES IN INJURED CELLS IN RELATION TO CELL RECOVERY. Maurice Errera (Université Libre, Brussels). J. Cellular Comp. Physiol., 58: Suppl. 1, 209-24 (Dec. 1961).

The ribonucleic acid and protein-synthesizing mechanisms in injured cells are discussed in relation to cell recovery. Results are given for studies with HeLa cells grown on glass cover slips or in quartz cuvettes, incubated, and exposed to a UV microbeam in the logarithmic phase. Measurements were made of nuclear synthesis of ribonucleic acid, protein metabolism, nucleo-cytoplasmic transfer of RNA, nucleo-cytoplasmic relationship in RNA and protein synthesis, the movement of RNA from nucleus to cytoplasm, and RNA synthesis and recovery processes. (C.H.)

7458 THE EFFECT OF ULTRAVIOLET LIGHT AND X RAYS ON AN ENZYME-FORMING SYSTEM. G. David

Novelli, Tadanori Kameyama, and J. M. Eisenstadt (Oak Ridge National Lab., Tenn.). J. Cellular Comp. Physiol., 58: Suppl. 1, 225-44(Dec. 1961).

Ultraviolet irradiation of E. coli cells was found to inhibit the induced synthesis of β-galactosidase and the inhibition was reversed by photoreactivation. Examination of crude extracts of such cells led to the discovery of a particle-bound fraction of β-galactosidase. The particle-bound enzyme occurs only in the presence of inducer. When inducer is removed, the enzyme leaves the particle and becomes associated with the soluble pool. These observations led to the discovery of a cell-free system that can synthesize the enzyme. The system consists of particles and supernatant, both of which must be prepared from pre-induced cells. The system requires the presence of inducer, a source of energy, amino acids, and the nucleoside di- and triphosphates. Enzyme synthesis is inhibited by chloramphenicol, glucose, ribonuclease and deoxyribonuclease. Ultraviolet treatment of the supernatant yielded an inactive preparation that could be made active by addition of DNA from untreated supernatant. Similarly x irradiation of cells destroyed induced enzyme synthesis and cell-free preparations made from x-irradiated cells were inactive. Such inactive preparations could synthesize enzyme when supplemented with DNA. Only DNA's prepared from cells containing the gene for β-galactosidase are effective. (auth)

7459 THE INFLUENCE OF X-RAY IRRADIATION UPON IMMUNITY TO THE CAUSATIVE ORGANISMS OF GAS-GANGRENE AND TETANUS. M. R. Nechaevskaya, V. M. Zhidovtsev, G. P. Cherkas, I. O. Zimina, and N. F. Kalinichenko. J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation), 32: 136-41(Dec. 1961).

Exposure of guinea pigs to x rays of 400 r after active immunization with the toxoids of the causative organisms of gas-gangrene and tetanus led to a certain decrease in the antitoxin titre to all types of antigens. The most considerable decrease in the antitoxin titre after irradiation was found in the sera of animals immunized with Cl. perfringens toxoid. The antitoxin titre decreased already after one day to 1/6th of the titre found in animals not exposed to radiation. The smallest decrease in antitoxin titre was found in animals immunized with tetanus toxoid. Prolongation of the period elapsed after the radiation to 5 days did not reveal a further decrease in the antitoxin titres found in the sera of the immunized animals. A certain discrepancy was observed between the antitoxin titre of immunized animals exposed to radiation and their resistance to infection with the corresponding bacterial species: notwithstanding the high antitoxin titre, the immunity after irradiation proved to be completely suppressed. The susceptibility of immunized animals to the causative organisms of gas-gangrene and tetanus decreased considerably after exposure to radiation and approached the susceptibility of unimmunized animals. (auth)

7460 THE POSSIBLE USE OF IONIZING RADIATION FOR THE STERILIZATION OF CERTAIN BIOLOGICAL PREPARATIONS. I. THE INFLUENCE OF IONIZING RADIATION UPON GAS-GANGRENE AND TETANUS ANTISERUM (SEROLOGICAL AND ELECTROPHORETIC INVESTIGATION). I. M. Goncharenko (Gamaleya Inst. of Epidemiology and Microbiology, U.S.S.R.). J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation), 32: 146-51(Dec. 1961).

The antitoxic properties and the relative proportion of the protein fractions of gas-gangrene and tetanus antisera were studied. The results show that the sterilization of dried antisera with γ rays caused no marked decrease in the antitoxin titre. Similar results were obtained with liquid antisera containing 0.3% mercamine. However, crude and concentrated liquid antisera after sterilization by radiation showed a marked decrease in antitoxin titre. Under the usual conditions, sterilization of liquid antisera appears to be inadvisable, not-withstanding the simplicity, convenience, and reliability of the method; sterilization of dried antisera, however, offers better prospects. (P.C.H.)

7461 SPLEEN CYTOLOGY STUDIES IN SWINE EXPOSED TO NUCLEAR RADIATION. C. F. Tessmer and A. Horava (Armed Forces Inst. of Pathology, Washington, D. C.). Lab. Invest., 10: 411-34(May-June 1961).

An analysis of the splenic changes, with general pathologic background, was carried out in 230 swine dying spontaneously from radiation doses of 13,290 to 410 r equivalent. By grouping the tissue and cytologic observations according to survival period, certain characteristic patterns were found in the spleen. These included graded levels of damage to the reticuloendothelial cells at higher lethal radiation doses. The most significant of these was the rather well demarcated finding at radiation levels above 9000 r in the reticuloendothelial tissues of the lymphoid germinal centers of an epithelioid change. At lower lethal levels, there were such reactive forms as macrophages, plasma cells, and altered lymphocytes. These provided an index of cell population at the various radiation levels with well identified corresponding forms in histologic and imprint preparations. (auth)

7462 EFFECT OF TRITIATED THYMIDINE ON THE GROWTH OF EHRLICH ASCITES TUMOR IN VIVO. Hermann Lisco, Edwin T. Nishimura, Renato Baserga, and Walter E. Kisielseki (Argonne National Lab., Ill. and Northwestern Univ., Chicago). Lab. Invest., 10: 435-43 (May-June 1961).

When multiple injections of tritiated thymidine are given to mice bearing Ehrlich ascites tumor, and 100% of the tumor cells become labeled, the growth of Ehrlich ascites tumor is markedly decreased when compared with control animals, the percentage decrease being proportional to the amount of tritiated thymidine given. However, even at the highest dose level the percentage decrease does not exceed 43%. These findings confirm the possibility of radiation damage from tritiated thymidine and suggest its use in the investigation of the direct effects of radiation on cells. (auth)

7463 DETECTING REVERSION IN T4rII BACTERIOPHAGE TO r^+ INDUCED BY ULTRA-VIOLET IRRADIATION. C. E. Folsome and D. Levin (Boston Univ.). Nature, 192: 1306(Dec. 30, 1961).

Details of a test developed for estimating the extent of reversion of bacteriophage T4B from rII to r^+ induced by ultraviolet irradiation are given. T4rII mutants were obtained by ultraviolet irradiation of T4Br phage, and 12 hr cultures of E. coli and K-12 (λ) were used in assays of rII and r^+ phage, respectively. The phage were diluted and irradiated in media which contained, per liter ion-free water, 10 g tryptone, 8 g sodium chloride, and 1 g glucose. Each of 12 rII mutant stocks was assayed on B and on K-12 (λ) to determine accurately the titer of total and of r^+ phage. It was found that 5 of the 12 mutants revert to r^+ when irradiated with ultraviolet. The extent of reversion ranges from 1.81 to 4.2×10^5 r^+ per 10^6 survivors. (P.C.H.)

7464 PITUITARY EFFECT ON SYNTHESIS OF DEOXYRIBONUCLEIC ACID IN REGENERATING RAT LIVER FOLLOWING WHOLE-BODY X-IRRADIATION. D. M.

Gould, K. W. Floyd, R. W. Whitehead, and J. L. Sanders (Univ. of Colorado Medical School, Denver). Nature, 192: 1309(Dec. 30, 1961).

The results of experiments on rats show that under conditions in which synthesis of DNA is active (19 hr postoperative), 750 r delivered either to the whole body or to the head will suppress synthesis of DNA in regenerating liver. Head shielding resulted in a markedly reduced synthesis and the administration of pituitary hormones immediately following irradiation further abolished DNA synthesis. It is concluded that irradiation of the head alone produced the same inhibition of DNA synthesis in regenerating liver as whole-body irradiation, and that DNA synthesis, although reduced, was present when the head was shielded. It is suggested that the reduction of DNA synthesis in animals with their heads shielded may be the result of adrenal stimulation following x irradiation. (P.C.H.)

7465 EFFECT OF PHOTOREACTIVATION ON ULTRA-VIOLET-INDUCED SEGREGATION OF HETEROZYGOUS DIPLOIDS. Robin Holliday (John Innes Inst., Bayfordbury, Hertford, Herts, Eng.). Nature, 193: 95-6 (Jan. 6, 1962).

The viability of ultra-violet irradiated conidia of Aspergillus sojae was significantly increased by treatment with visible light. It was concluded that the effect of ultra-violet light in inactivating diploid conidia may be distinct from that which induces somatic segregation. Results are compared with those from a similar experiment with a heterozygous diploid of Ustilago maydis. (C.H.)

7466 RADIATION-INDUCED GENETIC DAMAGE IN THE MEXICAN TOAD (BUFO VALLICEPS). W. Frank. Blair (Univ. of Texas, [Austin]). Texas J. Sci., 12: 216-27 (Oct. 1960).

Lines of Mexican toads (Bufo valliceps) bearing x-ray induced genetic damage were established by mating normal females with males that had received gonadal x-ray doses ranging from 300 to 3000 r. Survival in the first generation was inversely proportional to dose, as was expected. Toads of the 300-r and 1000-r lines were inbred, and toads of these lines and of the 700-r line were outcrossed to normal ones. Two crosses were made between toads of the 500-r and 1000-r lines. Developmental abnormalities of various kinds appeared at life history stages ranging from early embryonic development to post-metamorphic life in both inbred and outcross generations. These included abnormal gastrulation and neurulation, larval and post-metamorphic edema, abnormally positioned or missing limbs, optical deficiencies, prognathous jaw due to excessive elongation of the lower jaw, and melanin deficiency. The prognathous jaw, in its extreme expression, would probably be lethal in natural populations because of difficulty of feeding. The melanin deficiency, in its extreme expression, is lethal as metamorphosis fails to occur, and in lesser expression, it appears to be lethal or detrimental. The various abnormalities do not appear to be inherited in any simple way, but instead they vary in expression both within and between generations, possibly in relation to genotype and environment. (auth)

7467 AEROGENIC IMMUNIZATION AND REIMMUNIZATION WITH LIVE BRUCELLOUS VACCINE AFTER IONIZING RADIATION. A. I. Maslov and G. N. Krivenkov. Voenno-Med. Zhur., No. 2, 27-31(1961).

Twenty-five guinea pigs were vaccinated aerogenically with live Brucella vaccine, and thirty were immunized intradermally for comparison. Both sets were divided into two groups; one was subjected to a 250 r dose of irradiation 5 hours before the injection of the vaccine, and the second group was used as immunization control. A third group of 10 guinea pigs received a similar radiation dose without subsequent vaccination (radiation control). The irradiated guinea pigs, vaccinated aerogenically, developed 3rd and 4th degree radiation sickness and 60% of the animals died in 8 to 14 days. The irradiated controls developed 2nd and 3rd degree radiation sickness with only 10% mortality in 30 days. The main causes of death were severe intestinal hemorrhages, autoinfection and, in two cases, widespread subpleural, interstitial hemorrhages throughout the whole lung with general hemorrhagic oedema. None of the non-irradiated and aerogenically vaccinated animals died, and dissection after vaccination revealed only hyperplasia of the reticulo-histiocytic elements of the lung and other organs and tissues. Guinea pigs irradiated and vaccinated intradermally, developed 2nd and 3rd degree sickness, and 10% died in 30 days. It was concluded that among guinea pigs aerogenically immunized with live Brucella vaccine five hours after irradiation with 250 r there is an increase in mortality in radiation sickness as compared with intradermally immunized animals and a depression of immunogenesis throughout the period of illness. (P.C.H.)

7468 IONIZIRUYUSHCHIE IZLUCHENIYA I VITAMINY. (OBZOR PROBLEMY I SOBSTVENNYE ISSLEDOVANIYA S VITAMINOM B_{12}). [Ionizing Radiation and Vitamins (A General Review and Special Investigations with B_{12})]. G. D. Berdyshev. Moscow, State Publishing House of Medical Literature (Medgiz), 1960. 140p.

The effects of ionizing radiation on vitamins in vitro in simple and complex systems are analyzed. The effects of radiation on vitamins in organisms and vitamin exchange in microorganisms, plants, animals, and humans are discussed, as well as the absorption and excretion of vitamins during radiation sickness. The protective and therapeutic effects of vitamins and combined drugs and vitamins in radiation exposures are considered. Extensive bibliographies are included in each chapter. (R.V.J.)

Radiation Sickness

7469 IRRADIATION AND MARROW INFUSION IN LEUKEMIA. E. D. Thomas, E. C. Herman, Jr., W. B. Greenough, III, E. B. Hager, J. H. Cannon, O. D. Sahler, and J. W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). A.M.A. Arch. Internal Med., 107: 829-45(June 1961).

Five patients with acute leukemia were treated by total-body irradiation and marrow infusion. Dose rates ranged from 0.5 to 2 r per minute. The first patient received 1,460 r followed by marrow from her mother. Marrow recovery occurred, but the patient died of infection after 21 days. The second patient received 1,768 r followed by fetal hematopoietic tissue and marrow from a brother. Death from infection occurred after 13 days with no evidence of a marrow graft. The third patient received 1,533 r followed by marrow from her sister. Death from infection occurred after 22 days with no evidence of a marrow graft. The fourth patient received 1,608 r followed by marrow from an identical twin. Marrow function returned and the patient left the hospital. Death from recurrent leukemia occurred after 72 days. The fifth patient received 2,016 r followed by marrow from an identical twin. Death from jaundice of undetermined etiology occurred after 20 days. Partial marrow recovery was evident at autopsy. (auth)

7470 POLAROGRAPHIC STUDY OF COPPER COMPLEXES WITH RADIATION PROTECTIVE DRUGS. CORRELATION OF INSTABILITY CONSTANT WITH RADIATION PROPHYLAXIS. Edward C. Knoblock and William C. Purdy (Walter Reed Army Inst. of Research, Washington, D. C. and Univ. of Maryland, College Park). J. Electroanal. Chem., 2: 493-6(Nov.-Dec. 1961). (In English)

A correlation was demonstrated between the instability constant of the copper-agent complex and the protective capacity of the agent against ionizing radiation. The instability constants for the complexes formed between copper and 8 agents in a Michaelis phosphate buffer of pH 7.4 are reported. The study offers a possible physiochemical method for the determination of the protective capacity of an agent. (auth)

7471 RADIOPROTECTIVE EFFECTS OF RESERPINE AND ITS N-OXIDE. Thomas J. Haley, A. M. Flesher, and L. Mavis (Univ. of California, Los Angeles). Nature, 192: 1309-10(Dec. 30, 1961).

The radioprotective effects of reserpine and its N-oxide were compared in mice following the administration of various doses of the two compounds 24 hr before x irradiation with 600 r. Both compounds produced typical reserpine effects, sedation and ptosis, but the N-oxide was less active per dose. Three doses of reserpine N-oxide significantly increased the ST_{50} day, whereas only one dose of reserpine demonstrated the same effect. On the basis of total survival, it requires twice as much reserpine as its N-oxide to decrease mortality by 25%. The possible mechanisms of both compounds are discussed. (P.C.H.)

7472 EFFECT OF POLYMERIZED DEOXYRIBONUCLEIC ACID ON THE ADRENAL GLANDS OF IRRADIATED RATS. V. Pantić (Univ. of Belgrade), N. Stosić, D. Kanazir, A. Bećarević, and G. Jovicki. Nature, 193: 83-4(Jan. 6, 1962).

Rats treated with highly polymerized nucleic acids survived lethal doses of irradiation. A high percentage of the animals injured by radiation returned quickly to initial body weight and showed an increase in splenic nucleic acids. The histology of adrenal glands in treated animals was investigated with the object of elucidating the mechanisms leading to recovery. (C.H.)

7473 OBSERVATIONS ON THE LATE EFFECTS OF INTERNALLY DEPOSITED MIXTURES OF MESOTHORIUM AND RADIUM IN TWELVE DIAL PAINTERS. W. H. Baker (Harvard Medical School, Boston and Massachusetts General Hospital, Boston), J. B. Bulkley, R. A. Dudley, R. D. Evans, H. B. McCluskey, J. D. Reeves, Jr., R. H. Ryder, L. P. Salter, and M. M. Shanahan. New Engl. J. Med., 265: 1023-8(Nov. 23, 1961).

Case-history data and Ra-MsTh burdens for 12 former luminous-dial painters who ingested toxicologically interesting quantities of these isotopes in the early 1920's are presented. With 1 exception, roughly 90% of the resulting skeletal irradiation has been attributable to the shorter-lived (five-and-seven-tenths-year) MsTh component of the radioisotope mixture. The signs and symptoms observed were consistent with expectations based on previously studied Ra cases. One tumor and several presumably pathologic fractures have occurred. Radiographically demonstrable skeletal changes were noted in all cases. No true blood dyscrasias were observed. Because of the small number of cases reported here, a detailed correlation of radiographic effect with burden of MsTh and Ra has not been attempted. (auth)

7474 PROTIVOLUCHEVYE SREDSTVA (SPRAVOCHNIK). (Radiation Protection Agents (Handbook)). L. A. Tiunov, G. A. Vasil'ev, and V. P. Paribok. Moscow, Publishing House of the Academy of Sciences, 1961. 172p.

The handbook offers extensive data on 500 preparations tested as prophylactic measures against radiation injuries in animals, plants, microorganisms, and other subjects. Quantitative data are tabulated in alphabetical order. Applications of several combined protective preparations and clinical evaluations of various protective measures are presented in separate tables. (R.V.J.)

CHEMISTRY

General and Miscellaneous

7475 (ORNL-TM-81) CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT SECTION B, QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1961. R. E. Blanco (Oak Ridge National Lab., Tenn.). Jan. 26, 1962. Contract W-7405-eng-26. 51p.

Research and development progress is reported on fuel dissolution, solvent extraction studies, corrosion studies, mechanisms of foam separation, waste treatment, ion exchange, and chemical applications of nuclear explosions. (M.C.G.)

7476 (JPRS-11688) THE PRODUCTION OF THIN ANTHRACENE MONOCRYSTAL PLATES. Jozsef Krajsovszky and Sandor Ujhelyi. Translated from Magyar Fiz. Folyoirat, 9: No. 1, 81-4(1961). 5p.

A technique is described for producing thin (0.2 to 0.3 mm) fluorescent anthracene plates by crystallization of the anthracene from the vapor phase. The crystals thus formed have a feather-like crystalline appearance, with branches and ridges. There are areas of undisturbed crystal growth, however, from which disks of diameters up to 3 cm may be cut. (T.F.H.)

Analytical Procedures

Refer also to abstract 7700

7477 (AEET/ANAL/1(Rev.)) CHEMICAL METHODS FOR THE DETERMINATION OF BORON IN REACTOR MATERIALS. PART I. ION-EXCHANGE SEPARATION OF BORON FROM COKES, PITCHES AND GRAPHITES AND ITS COLORIMETRIC DETERMINATION BY THE CURCUMIN-TRI-CHLORACETIC ACID METHOD. H. B. Desai, S. R. Desai, M. N. Nadkarni, R. N. Naik, M. S. Pendharkar, and M. Sankar Das (India. Atomic Energy Establishment, Trombay). 1961. Originally issued in 1959. 17p.

A procedure has been standardized for the determination of boron in cokes, pitches, and graphites. The method consists of fixing the boron present in the sample as calcium borate, ion-exchange separation of boric acid from the associated cations, and the colorimetric determination of boron using the curcumin-trichloracetic acid method. Sulfur which is usually present in pitches and cokes is expected to be oxidized to sulfate during the fixation of boron and hence its effect on the colorimetry has been studied. Application of the procedure to the determination of 0.50 and 1.00 microgram amounts of boron, has given coefficients of variation of 10.0 and 6.7% respectively. (auth)

7478 (AEET/ANAL/2(Rev.)) CHEMICAL METHODS FOR THE DETERMINATION OF BORON IN REACTOR MATERIALS. PART II. ISOLATION OF BORON BY METHYL BORATE DISTILLATION AND ITS COLORIMETRIC DETERMINATION BY THE CIRCUMIN-TRICHLORACETIC ACID METHOD. H. B. Desai, M. S. Pendharkar, and M. Sankar Das (India. Atomic Energy Establishment, Trombay). 1961. Originally issued in 1959. 20p.

Procedures were standardized for the determination of 0.04 to 1 ppm of boron in uranium and thorium metals and compounds. It consists of distillation of boron as methyl borate, hydrolysis of methyl borate in dilute sodium hydroxide solution, and colorimetric determination of boron using the curcumin-trichloracetic acid method. When excess alkali is used for the hydrolysis of methyl borate, an ion-exchange separation stage is included in the conventional method for the removal of excess alkali as otherwise poorer recoveries of boron are obtained. Details are given for the treatment of different types of samples such as uranium metal, oxide, nitrate solutions, sodium diuranate, uranium tetrafluoride, thorium nitrate, and graphites containing large amounts of fluoride. (auth)

7479 (AERE-R-3784) A CONSTANT POTENTIAL COULOMETRIC TITRATION EQUIPMENT USING TRANSISTORS. J. J. Rockett (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 52p.

The application of transistor circuits to the control of potential between a liquid and a working electrode are considered together with methods of integrating the resulting current flow. Proven circuits are described. (auth)

7480 (NAA-SR-6804) DETERMINATION OF IODIDE IN LEAD TELLURIDE SEMICONDUCTOR. Louis Silverman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 15, 1962. Contract AT(11-1)-Gen-8. 13p.

PbTe (99.5 to 99.9%) is dissolved in dilute HNO_3 under reflux. The PbI_2 is partially converted to I_2 by the oxides of nitrogen, and completely with the aid of H_2O_2. The I_2 is extracted into o-xylene and the absorbance is measured at 495 mμ. (auth)

7481 (NYO-9690) DEVELOPMENT OF ISOTOPE DILUTION TECHNIQUES FOR ASSAY OF FOOD ADDITIVES. Quarterly Status Report No. 2, September 15, 1961–December 15, 1961. (Nuclear Science and Engineering Corp., Pittsburgh). Contract AT(30-1)-2715. 8p.

Isotope dilution techniques are described for the assay of chlorinated hydrocarbon pesticides and organic phosphorus pesticides in foods. Results are given for the determination of tetranitro-DDT-dianilide, dianilide of tetranitro-DDE, dieldrin, systox, and derivatives of these compounds. (C.H.)

7482 (PG-Report-268) ANALYTICAL METHOD FOR THE DETERMINATION OF PHOSPHORUS IN BERYL ORE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1961. 6p.

An analytical method is described for the determination of P in beryllium ores. A weighed portion of the ore sample is fused with sodium hydroxide. The cooled melt is leached with water and the solution neutralized. Ammonium nitromolybdate reagent is added and the precipitated ammonium phosphomolybdate separated. This is purified by a further precipitation before drying and weighing. Specialized techniques minimize the spreading of dry materials and reduce the hazards from inhalation of Be dust. (C.H.)

7483 (UCRL-9908) ACTIVATION ANALYSIS FOR OXYGEN AND OTHER ELEMENTS BY MEANS OF He^3-INDUCED REACTIONS. Samuel S. Markowitz and John D. Mahony (California. Univ., Berkeley. Lawrence Radiation Lab.). Nov. 9, 1961. Contract W-7405-eng-48. 36p.

A simple and rapid activation analysis has been performed for oxygen in samples of beryllium, thorium, and

Mylar. The ultimate sensitivity is in fractions of a part per billion. Milligram amounts of total sample are sufficient. The method can be used to analyze for other elements and for specific nuclides. It is possible to determine more than one element in the same activation. It is not necessary to destroy the sample. The use of He^3 as the incident projectile is important; because of its low binding energy many He^3 nuclear reactions are exoergic, permitting radioactive products to be formed with large cross section from a beam of low kinetic energy. The absolute excitation function has been determined for the production of F^{18} from O^{16} reaction with He^3 ions of kinetic energy up to 31 Mev. The induced radioactivity was measured by calibrated end-window proportional counters and by NaI scintillation spectroscopy. A brief bombardment of a 0.001-inch thorium foil with 0.01-μa of He^3 gave sufficient F^{18} radioactivity from O^{16} impurity to easily distinguish the 0.51-Mev annihilation radiation from the nuclear γ rays emitted by thorium and its daughters. The methods for eliminating or minimizing interferences are discussed. An extensive table lists nuclear reactions of low-energy He^3 ions with nuclides up to Ca^{48}, product half-lives, and reaction Q values. (auth)

7484 (Y-1376) DETERMINATION OF TRACE AMOUNTS OF SULFUR IN GRAPHITE. L. M. Steckel (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Dec. 19, 1961. Contract W-7405-eng-26. 15p.

A direct combustion-iodometric titration method has been developed for the determination of trace quantities of sulfur in graphite. The method, applicable for as little as 25 micrograms of sulfur per gram of graphite, had an observed limit of error (0.95) for a single determination of ±5 μg sulfur. (auth)

7485 (AEC-tr-4895) BENZYLISOTHIOUREA AND ITS APPLICATION TO THE IDENTIFICATION OF ORGANIC ACIDS. S. Veibel and H. Lillelund. Translated by L. M. Ferris (Oak Ridge National Lab., Tenn.) from Bull. soc. chim. France, (5) 5: 1153-8(1938). 8p.

The synthesis and polymorphism of benzylisothiourea hydrochloride and its application to identification of organic acids are described. A table of 23 benzylisothiourea salts of organic acids is given. (auth)

7486 (AEC-tr-4896) BENZYLISOTHIOUREA AND ITS APPLICATION TO THE IDENTIFICATION OF ORGANIC ACIDS. S. Veibel and K. Ottung. Translated by L. M. Ferris (Oak Ridge National Lab., Tenn.) from Bull. soc. chim. France, (5) 6: 1434-5(1939). 3p.

The use of benzylisothiourea hydrochloride as an analytical reagent for the identification of organic acids is discussed. Salts of 15 organic acids were prepared and the melting points and analyses of the salts are given. (M.C.G.)

7487 (JPRS-10874) THE DETERMINATION OF SODIUM IN TELLURIC ACID BY NEUTRON ACTIVATION AND GAMMA-SPECTROMETRY. J. Malinowski. Translated from Nukleonika, 6: No. 3, 211-13(1961). 3p.

A method is described for determination of Na, in the concentration range of 100 to 500 ppm, in telluric acid. The acid sample is exposed for 15 min to a neutron flux of $6.3 \times 10^{12}/cm^2$ sec, and the Na content is determined by measuring the intensity of the 1.37-Mev γ transition in Na^{24}. (T.F.H.)

7488 (JPRS-11689) THE ANALYTICAL CHEMISTRY OF PLUTONIUM. Dieter Nebel. Translated from Chem. Tech., Leipzig, 13: 522-9(Sept. 1961). 19p.

The general chemical properties of Pu are given. Methods for separating Pu, including solvent extraction, ion exchange, and precipitation, are reviewed. Techniques for Pu determination, e.g. by absorption or emission spectrophotometry, electrochemical methods, potentiometry, polarographic methods, complexometry, and radiometry, are discussed. (T.F.H.)

7489 NEUTRON ACTIVATION PAPER CHROMATOGRAPHIC ANALYSIS OF PHOSPHOLIPIDS IN HUMAN LIVER AND BILE. Fumio Nakayama and Rolf Blomstrand (Univ. of Lund, Sweden). Acta. Chem. Scand., 15: 1595-1603(1961). (In English)

Phospholipids in human liver and bile were analyzed using a neutron activation paper chromatographic technique. Phosphatidylserine, phosphoinositide, and choline plasmalogen as well as lecithin, phosphatidylethanolamine, and sphingomyelin were found to be present. Further evidence for the presence of lysolecithin in normal human bile is also presented. Similar results were obtained with rat bile using radioactive phosphorus. Lecithin comprises more than 80% of the phospholipids in human bile in contrast to liver, where it comprises 45%, indicating a selective secretion of phospholipid classes from liver into bile. The difference found in the fatty acid composition of the total phospholipids in human liver and bile by gas chromatography, coincides with the findings on the differences in phospholipid composition. (auth)

7490 DETERMINATION OF TRITIUM AND CARBON-14 IN AQUEOUS SOLUTION WITH ANTHRACENE POWDER. Eric Schram and Robert Lombaert (Université, Brussels). Anal. Biochem., 3: 68-74(Jan. 1962). (In English)

A method is described for the counting or recording of carbon-14 and tritium activities in aqueous solutions by means of an anthracene powder cell. Efficiencies of 44 and 2%, respectively, are obtained for an effective volume of 1 ml and with a background of about 60 counts/min at ordinary temperature. (auth)

7491 THE SIMULTANEOUS DETERMINATION OF C^{14} AND H^3 IN THE TERMINAL GROUPS OF GLUCOSE. Ben Bloom (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Anal. Biochem., 3: 85-7(Jan. 1962). (In English)

A method is described that permits the simultaneous determination of C^{14} and H^3. The dimedon derivative of formaldehyde, which is soluble in toluene phosphor solution, was prepared from the position-6 group of glucose and contains its two hydrogens and carbon. The H^3 and C^{14} activities were simultaneously measured in accord with the discriminator ratio method using a liquid scintillation counter. Two scintillation solvent systems were utilized. The yields were generally about 45 mg, representing 75% theory. (P.C.H.)

7492 A RAPID METHOD FOR THE DIRECT DETERMINATION OF ELEMENTAL OXYGEN BY ACTIVATION WITH FAST NEUTRONS. Dean J. Veal and C. F. Cook (Phillips Petroleum Co., Bartlesville, Okla.). Anal. Chem., 34: 178-84(Feb. 1962).

An analytical method is described for the analysis of oxygen in samples which contain no fluorine or boron, by means of activation with fast neutrons. The nondestructiveness and the fivefold increase in speed over the conventional Unterzäucher method are shown. With neutron source strengths readily available from Cockcroft-Walton accelerators (10^9 neutrons per second), a sensitivity of 0.032% oxygen is obtainable. At an oxygen level of 1%, the accuracy of the method is ±17%. (auth)

7493 DETERMINATION OF OXYGEN BY ACTIVATION ANALYSIS WITH FAST NEUTRONS USING A LOW-COST PORTABLE NEUTRON GENERATOR. Edgar L. Steele and W. Wayne Meinke (Univ. of Michigan, Ann Arbor). Anal. Chem., 34: 185-7(Feb. 1962).

Fast neutron activation analysis, using a low-cost Cockcroft-Walton design accelerator as a source of 14-Mev (deuterium-tritium) neutrons, was found satisfactory for trace oxygen determination. This method is rapid, sensitive, and selective, and is free from most matrix interferences. Yet it uses equipment costing no more than good infrared or spectrographic instruments. Fast neutrons (>10 Mev) convert O^{16} by an (n,p) reaction to 7.4-sec N^{16}. This in turn emits 6 to 7 Mev γ rays which are measured by scintillation spectrometry. Samples containing 10 mg or more of oxygen were analyzed to within ±10% with a fast flux of ~10^8 n cm^{-2} sec^{-1}. Larger samples give smaller errors. By using all the sample area available with an average flux for irradiation of 10^8 n cm^{-2} sec^{-1} and using a proper transfer system, it should be possible by this nondestructive method to analyze to within ~ ±10 to 15% for as low as 10 ppm of oxygen. The average time for an analysis, including weighing, is approximately 7 minutes. The only interference encountered is from fluorine and this can be compensated for at F/O ratios below 10. (auth)

7494 NITROGEN-13 IN HYDROCARBONS IRRADIATED WITH FAST NEUTRONS. J. T. Gilmore and D. E. Hull (California Research Corp., Richmond). Anal. Chem., 34: 187-90(Feb. 1962).

The concentration of nitrogen in hydrocarbons can be measured by means of the 10-minute N^{13} activity produced by irradiation with 14-Mev neutrons. The analysis is simple and gives valid results in the percent concentration range. Attempts to extend it to the ppm range failed because even the purest hydrocarbons irradiated with fast neutrons give rise to a N^{13} activity corresponding to several hundred ppm of N. This activity does not arise from N or any other impurity, but it is produced inherently in hydrogen–carbon systems at this energy by the reaction $H^1 + C^{13} = N^{13} + n^1$. The protons receive the necessary energy by recoil from collision with fast neutrons. (auth)

7495 ANALYSIS OF CESIUM AND RUBIDIUM SALTS AND METALS. M. C. Farquhar and J. A. Hill (American Potash and Chemical Corp., Trona, Calif.). Anal. Chem., 34: 222-4(Feb. 1962).

Flame photometry was found to be the best method for determining alkali-metal impurities in rubidium and cesium. However, emission intensities are enhanced by factors of four to five by the major component. Furthermore, enhancement factors vary 20 to 30% (depending on concentration). This severe enhancement is overcome by the simulated standards method, and determinations of minor components are accurate to within ±2.8% of the amount present, at the 95% confidence level. Assays for major component alkalies are accomplished by conversion to sulfates and correcting the weight of sulfates for determined impurities. These determinations are accurate to within ±0.16% of the amount present at the 95% confidence level. (auth)

7496 RADIOCHEMICAL ANALYSIS OF IRRADIATED POLYPHENYLS. F. F. Felber, Jr. and R. C. Koch (Nuclear Science and Engineering Corp., Pittsburgh). Anal. Chem., 34: 280-3(Feb. 1962).

Analytical procedures were developed for radiochemical determination of 15 radionuclides in small quantities of irradiated polyphenyls. After a carefully controlled treatment with perchloric acid, the procedures utilize sequential elemental separations to provide optimum analytical sensitivities. Nine of the fifteen nuclides were analyzed in sufficient quantities and at net counting rates sufficiently high to permit statistical evaluation of the procedures. Average precisions, at the 95% confidence level, achieved in a series of replicate analyses for these nine nuclides varied from 3.4 to 5.2%. (auth)

7497 RADIOCHEMICAL DETERMINATION OF YTTRIUM AND PROMETHIUM. A PRECIPITATION TECHNIQUE. M. E. Pruitt, R. R. Rickard, and E. I. Wyatt (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 283-7(Feb. 1962).

A procedure is presented for separating yttrium from the lanthanum group of rare earth elements by precipitating the latter as iodates. Yttrium remains in solution and is determined separately. In fission product mixtures that have cooled a year or longer, Pm^{147} can be determined readily after the separation of the lanthanum group elements from yttrium. Other applications of the general technique are suggested. (auth)

7498 GAMMA RAY ABSORPTIOMETER FOR DETERMINATION OF URANIUM IN AQUEOUS AND ORGANIC SOLVENT SOLUTIONS. S. J. Broderick (U. S. Atomic Energy Commission, New Brunswick, N. J.). Anal. Chem., 34: 295-6(Feb. 1962).

A gamma ray spectrum of Am^{241} was prepared, and the influence of slit widths on the absorption characteristics was determined. Variable slit widths of $\frac{1}{2}$ to $\frac{1}{8}$ in. were found to show no appreciable effect upon the shape of the diagrams. Also, the slight change in cell length with the $\frac{1}{2}$ in. slit does not affect the absorption. A straight line relation holds between the uranium concentration (10 to 150 g of U per liter) and log of current in a 22 mm diameter sample tube. There is a slight divergence from a straight line at the higher concentrations (150 to 550 g of U per liter). With a $\frac{1}{2}$ in. wide slit, the current generated in the ionization chamber by the Am^{241} source is decreased to 2.2×10^{-8} amp. (P.C.H.)

7499 A BASIS FOR THE DETERMINATION OF DISSOLVED OXYGEN BY ELECTRON SPIN RESONANCE SPECTROSCOPY. R. B. Ingalls and G. A. Pearson (Atomics International, Canoga Park, Calif.). Anal. Chim. Acta, 25: 566-9(Dec. 1961). (In English)

The fact that the ESR spectrum of certain free radicals in solutions is strongly affected by dissolved oxygen can be used as a basis of a simple method for the determination of molecular oxygen in organic solutions. It should be of particular value in the quantitative determination of low concentrations of oxygen in the region of 10^{-5} to 10^{-3} normal. (auth)

7500 RADIOMETRIC TRACE ANALYSIS. QUANTITATIVE PAPER CHROMATOGRAPHY OF LEAD WITH PHOSPHATE-^{32}P. P. C. van Erkelens (Institute for Animal Husbandry "Schoonoord," Utrecht). Anal. Chim. Acta, 25: 570-8(Dec. 1961). (In English)

A method is described for the selective determination of lead in paper chromatograms, down to 1 μg (standard deviation 11%). After development and drying, the lead spot is sprayed with a $Na_2H^{32}PO_4$ solution and dried. Excess reagent and alkaline earth phosphates are eluted with a borax–oxalate buffer of pH 8.0. Eventually, the radioactivity of the lead spot is measured. The filter paper renders the method about 40 times more sensitive than existing radiometric techniques with phosphate-P^{32}. The method can be modified for the simultaneous determination of many cations. (auth)

7501 THE DETERMINATION OF URANIUM IN FAIRLY PURE BERYLLIUM METAL BY NEUTRON ACTIVATION AND GAMMA SPECTROMETRY. A. A. Smales, D. Mapper, and A. P. Seyfang (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Anal. Chim. Acta, 25: 587-97(Dec. 1961). (AERE-R-3313) (In English)

A method is described for the determination of trace quantities of uranium in beryllium metal. The beryllium samples are irradiated in polytainers for 1.5 to 2 hr in a flux of 10^{12} neutrons/cm^2/sec allowed to stand for 24 hr, then measured directly without any further treatment on a γ spectrometer. The radionuclide used is 2.33-day Np^{239}, which produces a satisfactory photo-peak with a 1 × 1.5 in. NaI(Tl) crystal and single-channel γ spectrometer. Dilute solutions (50 μg/ml) of uranium are used as standards, and after irradiation, prepared in similar polytainers as used for the samples. As little as 1 ppm of uranium can be determined in 0.5 g samples of beryllium metal; for greater sensitivity radio-chemical separations would be required. Much of the radioactivity produced in the sample is due to the impurities it contains, and it is this radioactivity which limits the sensitivity of the direct γ spectrometric method. Full details of the method are given, and various factors which may be a source of error are discussed. (auth)

7502 EMISSION SPECTROSCOPY OF SOLUTIONS. A REVIEW. L. G. Young (Admiralty Materials Lab., Poole, Dorset, Eng.). Analyst, 87: 6-24(Jan. 1962).

A review is given of various methods employed to get the sample solution into the spectroscopic source and excited. The methods are divided into 8 classifications; flame spectrophotometer, flame photometer, flame spectrograph, impregnated-electrode spectrograph, dried powder spectrograph, porous-cup spectrograph, rotating-disc spectrograph, and other solution methods. Some typical applications of spectroscopic solution methods are included in the appendix. A detailed literature survey was made, and 280 references are given. (P.C.H.)

7503 THE ANALYSIS OF COMPLEX ALLOYS, WITH PARTICULAR REFERENCE TO NIOBIUM, TANTALUM AND TUNGSTEN. THE DISTRIBUTION OF METALLIC IONS BETWEEN ION-EXCHANGE RESINS AND HYDROCHLORIC–HYDROFLUORIC ACID SOLUTIONS. J. B. Headridge and E. J. Dixon (Univ. of Sheffield, Eng.). Analyst, 87: 32-42(Jan. 1962).

The distribution coefficients of Al, Ti^{4+}, Zr, V^{4+}, V^{5+}, Nb^{5+}, Ta, Cr^{2+}, Mo^{6+}, W^{6+}, Mn^{2+}, Fe^{3+}, Co^{2+}, Ni, and Cu^{2+} between the ion-exchange resins De-Acidite FF and Zeo-Karb 225 and up to 10 M hydrochloric acid (and mixtures 1 M in hydrofluoric acid and up to 10 M in hydrochloric acid) were determined. From a study of the results, a scheme is proposed for the separation of these elements into more manageable groups. (auth)

7504 THE VOLUMETRIC DETERMINATION OF NIOBIUM IN THE PRESENCE OF TANTALUM. J. B. Headridge and M. S. Taylor (Univ. of Sheffield, Eng.). Analyst, 87: 43-8(Jan. 1962).

A volumetric method for the determination of niobium is described. Niobium(V) in 6 M hydrochloric–0.5 M hydrofluoric acid solution is reduced quantitatively in a Jones reductor to niobium(III). The solution containing the niobium(III) species is collected in ammonium ferric sulfate solution, in which an amount of ferrous iron is produced equivalent to the amount of niobium present. The ferrous iron is determined by titration with 0.1 N potassium dichromate. Amounts of niobium from 1.0 to 50 mg were determined alone and in the presence of different amounts of tantalum. The method was applied to the determination of niobium in ferrous and non-ferrous alloys. (auth)

7505 ANALYSIS OF ORES AND MINERALS BY MEANS OF THE RADIOLUMINESCENCE INDUCED BY THE α-RADIATION OF POLONIUM-210. I. N. Plaksin, M. A. Belyakov, and L. P. Starchik. Atomnaya Energ., 11: 548-9(Dec. 1961). (In Russian)

The great weight of the cathodic luminescence devices which are widely used for the analysis of minerals makes it inconvenient to employ them in the field. On the other hand, α-radiation sources, in particular Po^{210} with a half-life of 138.3 days, present the great advantage of ease of handling; Po^{210} emits only 1 γ quantum for each 10^5 α-particles, thus requiring little shielding. The visual analysis can be carried out very simply. A 1.8-curie source was used successfully for observing the radioluminescence of calcite, dolomite, fluorite, scheelite and beryl. Exposure to α-radiation induced a strong radioluminescence in diamonds and enabled the use of α-rays instead of γ-radiation for sorting them. The current generated was amplified by a factor of 10^4 to 10^5. The low penetration of this radiation simplifies the shielding problem. In certain cases, α-induced nuclear reactions may be used for analytical purposes. (TTT)

7506 ABSORPTIOMETRIC DETERMINATION OF MICRO-AMOUNTS OF IRON IN NUCLEAR GRADE GRAPHITE AND URANIA–GRAPHITE FUEL; NITROSO SALT METHOD AFTER COPRECIPITATION OF IRON WITH MANGANESE DIOXIDE. Masatoshi Miyamoto (Tokyo Electrode Mfg. Co., Ltd.). Bull. Chem. Soc. Japan, 34: 1435-40(Oct. 1961). (In English)

An absorptiometric determination of microamounts of iron with nitroso R salt was satisfactorily applied to the routine analysis of nuclear grade graphite. An ashed sample is brought into a solution and the color of iron is developed by the reagent with the aid of hydroxylamine sulfate. Adjustment of pH to the optimum range is easily made by the addition of a definite amount of an acetate buffer. The intensity of the color is measured at 715 mμ. The range of the determination covers 2 to 75 ppm when 1 g of a sample is taken, the final volume being 25 ml. In the case of a sample of urania-graphite fuel, the ash is fumed with perchloric acid and a preliminary separation is made by coprecipitation with manganese dioxide which is produced by the oxidation of manganese(II) ion with hydrogen peroxide in a hot ammoniacal carbonate solution. The recovery of iron is quantitative and the removal of diverse ions is satisfactory. All of the uranium is also removed. Contamination with foreign iron from a drill used for sampling and from the platinum or porcelain crucibles used is negligible. The effect of diverse ions on the absorptiometry was also examined. (auth)

7507 SPECTROPHOTOMETRIC DETERMINATION OF CERIUM(IV) IN THE PRESENCE OF AN EXCESS OF CERIUM(III) AND OF TITANIUM(III) IN THE PRESENCE OF AN EXCESS OF TITANIUM(IV). F. Berbeek (Université, Ghent). Bull. soc. chim. Belges, 70: 415-22(July-Aug. 1961). (In French)

The spectrophotometric determination of traces of Ce^{4+} and Ti^{3+} in the presence of respectively large excesses of Ce^{3+} ($\leq 10^{-1}$ M) and Ti^{4+} ($\leq 10^{-1}$ M) is described. Indirect methods are given for both ions. The reaction of Ce^{4+} with an excess of Fe^{2+} gives an equivalent amount of Fe^{3+} which can be determined with thiocyanate. The determination of the unreacted Fe^{2+} with o-phenanthroline is also possible. The reaction of Ti^{3+} with an excess of Fe^{3+} gives an equivalent amount of Fe^{2+} which can be determined with o-phenanthroline. (auth)

7508 INDICATORS FOR NONAQUEOUS ACID-BASE TITRIMETRY. John T. Stock and William C. Purdy (Univ.

of Connecticut, Storrs and Univ. of Maryland, College Park). Chemist Analyst, 48: 22-8; 50-3; 55-6(1959).

A literature review is presented on indicators for visual or photometric detection of the end point in non-aqueous acid-base titrimetry. 309 references are given for the period through June 1958. The nature of the method is briefly discussed along with the uses of various indicators. The indicators considered are grouped according to chemical structure and within each group according to present importance. (P.C.H.)

7509 INDICATORS FOR NONAQUEOUS ACID-BASE TITRIMETRY. DEVELOPMENTS, 1959-1961. William C. Purdy and John T. Stock (Univ. of Maryland, College Park and Univ. of Connecticut, Storrs). Chemist Analyst, 50: 88-90; 92-3(1961).

A literature review is presented on indicators reported useful for visual or photometric detection of the end point in non-aqueous acid-base titrimetry. 107 references are given for those reported since June 1958. The indicators are grouped according to chemical structure and within each group according to present importance. (P.C.H.)

7510 DETERMINATION OF THORIUM IN ORES. Setsuro Sekine and Tsunekazu Mochizuki. Chishitsu Chosasho Geppo, 12: 197-200(Mar. 1961). (In Japanese)

A procedure for the determination of thorium in ores is as follows: The sample is decomposed with perchloric and hydrofluoric acids and is dissolved in hydrochloric acid. The residue is reserved. Sodium hydroxide precipitation is made and the precipitate is dissolved in nitric acid (solution A). The reserved residue is then used with sodium peroxide and sodium carbonate (1 + 1). The melt is treated with water, and the precipitate is dissolved in nitric acid (solution B). (A) + (B) is treated with ammonia and the precipitate is dissolved in nitric acid. The solution is diluted to 10 ml (containing 1.5 ml of free acid) and EDTA is added (0.1 g of EDTA for 25 mg of ZrO_2), followed by 19 g of crystal aluminum nitrate. The solution is extracted with mesityl oxide, and thorium is transferred to the aqueous phase by shaking the extract with water. Thorium is then titrated with a standard solution of EDTA using xyenol orange as an indicator, or determined by spectrophotometry with arsenazo (580 mμ). (auth)

7511 ON THE EXPERIMENT ON THE ANALYSIS OF THE HEAVY WATER BY INFRA-RED SPECTROMETRY. T. Okabe. Denki Shikensho Ihô, 25: 679-86(Sept. 1961). (In Japanese)

An analysis of heavy water content was performed with an accuracy better than 0.001% by means of an infrared spectrometer in which the voltage and frequency of the electrical source are kept constant. A thin semiconductor film such as KSe is used in picking up the penetrating beam, the frequency of which is 800 c/s, and a grating spectrum system is adopted. (auth)

7512 SPECTROGRAPHIC DETERMINATION OF SMALL AMOUNTS OF HAFNIUM IN ZIRCONIUM OXIDE. Ken-ju Ch'en. Hua Hsüeh Tung Pao, No. 3, 37-9(1960).

The specimen is vaporized in an opening in the carbon electrode. The spectrum is photographed with a medium spectrograph and the analysis is made by the lines Hf 2641.4–Zr 2642.5 A in the concentration range 0.003–1%. (auth)

7513 DETERMINATION OF THE SANGUINE IODINE CONTENT BY ACTIVATION ANALYSIS. C. Kellershohn, D. Comar, and C. Le Poec (Commissariat a l'Énergie Atomique, [Paris]). Intern. J. Appl. Radiation and Isotopes, 12: 87-103(Dec. 1961). (In French)

Two methods of measuring the iodine content of the blood by activation analysis after 30 min irradiation in a flux of 6×10^{12} n/cm^2 sec are described. One method includes a chemical separation of iodine before irradiation. The radioactivity of this specimen is determined on the basis of the amplitude of the iodine-128 photoelectric peak measured by γ spectrometry. The sensitivity of this method is about 10^{-9} g. The other includes chemical separation after irradiation, and radioactivity is subsequently measured with a Geiger-Mueller counter. The sensitivity of this second method is about 10^{-10} g, sufficient for determination of the plasmatic mineral content. The advantages of activation analysis over the conventional method based on colorimetric measurement of the catalytic action of iodine in the oxidation of arsenious anhydride with ceric sulfate are discussed. Initial results obtained with this new form of analysis are detailed as are also the possibilities of measuring plasmatic proteic iodine by scintillation spectrometry without prior chemical separation. (auth)

7514 THE ESTIMATION OF SMALL CONCENTRATIONS OF DEUTERIUM OXIDE IN WATER BY THE FALLING DROP METHOD. F. E. Hytten (Maternity Hospital, Aberdeen, [Eng.]), Nan Taggart, W. Z. Billewicz, and A. C. Jason. Phys. in Med. Biol., 6: 415-25(Jan. 1962).

The falling drop method for the measurement of small concentrations of D_2O has been studied with the object of defining a set of conditions which would give the best results in practice. A particular study has been made of the design of the tube which holds the dropping medium and of the control of temperature. In the range of concentration 0.1 to 0.2g% D_2O, the accuracy achieved is of the order of ±0.0015g% D_2O. (auth)

7515 CONTRIBUTION TO THE DETERMINATION OF OXYGEN IN MOLYBDENUM, TUNGSTEN, TANTALUM, AND NIOBIUM AS WELL AS IN HARD CARBIDES AND HARD METALS BY HEAT EXTRACTION. E. Woefel and E. Lassner (Metallwerk Plansee A.G., Reutte/Tirol, Austria). Planseeber, Pulvermet., 9: 162-9(Dec. 1961). (In German)

For the determination of oxygen in refractory metals and their alloys as well as in hard carbides and hard metals, a vacuum fusion apparatus was used and the working conditions for these materials optimized. The changes in oxygen content during the various production stages of molybdenum, tungsten, tantalum, and niobium could be followed with a considerable reproductibility. The results obtained on carbides and hard metals are in agreement with practical experiences. (auth)

7516 THE "NULL MATRIX" IN NEUTRON DIFFRACTION. B. G. Lyashchenko (Inst. of Metallography and Physics of Metals, USSR). Soviet Phys.-Cryst., 6: 404-7(Jan.-Feb. 1962).

Some aspects of a new, progressive technique in neutron diffraction are considered. Its applications in studies of the physics of high pressures, magnetism, and minor impurity concentration distributions in metals and alloys are discussed. (auth)

7517 DETERMINATION OF SULPHUR IN PETROLEUM SAMPLES. Peter Reginald Morris and Alan James Porter (to Esso Research and Engineering Co.). British Patent 886,030. Jan. 3, 1962.

A method and apparatus are described for measuring the sulfur content of liquid or gaseous petroleum streams by means of x-ray absorption. Means are provided for continuous recording of the measured contents and for setting 0.1% sulfur content as the minimum or maximum detectable limit. (D.L.C.)

General Inorganic and Physical Chemistry

7518 (ANL-6472) THE HEATS OF FORMATION OF SOME INORGANIC COMPOUNDS BY FLUORINE BOMB CALORIMETRY. Stephen S. Wise (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-eng-38. 78p.

The application of precision bomb calorimetry to determining heats of formation of many compounds is possible through the development of techniques for the use of high-purity fluorine as the bomb oxidant. A description is given of methods and materials which were used for handling fluorine safely in routine calorimetric experiments. The construction of suitable combustion bombs and the availability of inert sample supports are discussed. The construction and operation of a two-chambered reaction vessel are given in detail. The vessel consists of a standard nickel combustion bomb surrounded by a nickel tank. A valve, which can be operated remotely, allows the flow of fluorine from the tank into the evacuated bomb where contact with the sample is made. The two-chambered vessel fits into a standard, rotating bomb calorimeter. Very few heats of formation of elemental fluorides are known with high precision; therefore, a redetermination program was initiated so that a firm foundation can be given to fluorine calorimetry. In this work, the standard heat of formation of boron trifluoride was verified as $-270.1_0 \pm 0.2_4$ kcal mole^{-1}. A new value for the heat of formation of silicon tetrafluoride was determined to be $-386.0_2 \pm 0.2_4$ kcal mole^{-1}. A value of $-59.5_1 \pm 0.7_2$ kcal mole^{-1} was derived for the heat of formation of boron nitride from the combination of the heat of combustion of BN in fluorine and the heat of formation of BF_3. The heats of combustion of two forms of silica with fluorine were measured. A combination of these with the heat of formation of SiF_4 yielded $-215.9_7 \pm 0.3_0$ kcal mole^{-1} as ΔH_f° for vitreous silica and $-217.7_4 \pm 0.3_3$ kcal mole^{-1} as ΔH_f° for alpha-quartz. A review of available thermochemical determinations suggested that the spectroscopically determined value of ΔH_f° for hydrogen fluoride (–65.1 ± 0.4 kcal mole^{-1}) is probably more nearly correct than the calorimetrically determined value (–64.4 ± 0.2 kcal mole^{-1}). (auth)

7519 (CRCE-1039) CHEMICAL ASPECTS OF THE USE OF SOLUBLE POISONS FOR REACTIVITY CONTROL IN CANDU. II. REACTOR POISON DEPOSITION ON MODERATOR SYSTEM SURFACES. R. E. Hollies and H. K. Rae (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1961. 39p. (AECL-1389)

The deposition of boron from boric acid and cadmium from cadmium sulfate solutions on Zircaloy, stainless steel, and aluminum was measured. On Zircaloy and stainless steel the amount deposited will have a negligible effect on reactivity in CANDU. Cadmium sulfate is recommended as the preferred soluble poison with the provision that the equivalent pH of the moderator be maintained at 6 or below. The small amount of deposition found can be explained in terms of ion exchange on the oxide film covering the metal. (auth)

7520 (CVNA-54(Rev.1)) TRANSPORT AND THERMODYNAMIC PROPERTIES OF SATURATED AND COMPRESSED HEAVY WATER. A. A. Bishop and P. A. Nelson (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Oct. 1961. For Carolinas Virginia Nuclear Power Associates, Inc., Charlotte, N. C. Contract [AT (30-1)-2289]. 80p.

Thermodynamic and transport properties of heavy water were reviewed, and graphs and tables containing values of these properties were compiled from the data found. It was assumed that pressure had the same relative effect on a thermodynamic or transport property of heavy water that it has on the corresponding property of light water at a given temperature. The desired properties of compressed heavy water were obtained and tabulated on the basis of this investigation. Large-scale enthalpy versus entropy charts are constructed with lines of constant pressure, constant temperature, and constant specific volume to eliminate the necessity of numerical cross-interpolation. (auth)

7521 (DC 59-9-122) X-RAY DIFFRACTION STUDIES OF EUROPIUM SESQUIOXIDE AND RELATED COMPOUNDS. R. C. Rau (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 11, 1959. Contract AT(11-1)-171. 11p.

Recently, europium sesquioxide (Eu_2O_3) and several related compounds were investigated by x-ray-diffraction techniques. A summary of results to date is presented and possible future applications of x-ray analysis of these compounds are pointed out. Standard powder patterns and unit-cell dimensions are given for the cubic and monoclinic forms of Eu_2O_3, and a discussion of some of the properties of Eu_2O_3 and related compounds is included. (auth)

7522 (IDO-14571) ELECTROLYTIC OXIDATION OF ZIRCONIUM IN NITRATE SOLUTIONS. M. R. Bomar (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 29, 1961. Contract AT(10-1)-205. 13p.

Zirconium alloys used in the fabrication of nuclear fuel elements can be disintegrated and converted to insoluble oxides by electrolytic treatment in concentrated nitrate solutions. This reaction shows promise as a technique for reprocessing nuclear fuels clad with Zircaloy-2. For a particular applied voltage, nitric acid achieves the highest rate of attack, but the reaction can be carried out at rates of 2 mg/(cm^2)(min) or greater in either 7.5M sodium nitrate or 2.3M aluminum nitrate. A reaction rate of 7 mg/(cm^2)(min) can be easily attained in either 8M nitric acid or 7.5M sodium nitrate. The rate of reaction is a function of the temperature and the applied voltage. An as-yet unsolved problem is the carry-down of uranium with the insoluble zirconium oxide product. (auth)

7523 (PAN-136) MEASUREMENT OF THE TEMPERATURE DEPENDENCE OF THE PROTON SPIN-LATTICE RELAXATION TIME IN LIQUID HYDROGEN SULPHIDE. J. W. Hennel and T. Waluga (Polish Academy of Sciences, Inst. of Nuclear Research, Krakow). July 1961. 7p.

Proton spin-lattice relaxation time T_1 in liquid H_2S at different temperatures between –18 and +55°C have been measured. The results show that T_1 decreases with increasing temperature. The possibility of explaining this fact by spin-rotational interaction is discussed. (auth)

7524 (SC-4655(RR)) IRREDUCIBLE REPRESENTATIONS OF LINE GROUPS. THE DYNAMICS OF POLYMER CHAINS. Katheryn E. Lawson and G. A. Crosby (Sandia Corp., Albuquerque, N. Mex.). Dec. 1961. Contract [AT (29-1)-789]. 34p.

The symmetries of infinite polymer chain molecules are discussed using the concept of line groups. Explicit directions are given for obtaining the irreducible representations of line groups employing the formalism developed for three-dimensional space groups. Line groups containing primitive and nonprimitive operations are discussed. Detailed considerations of the line group V_h are given with specific applications to the polyethylene molecule. Direc-

tions for generating symmetry-adapted vibrational coordinates for chain molecules are outlined. (auth)

7525 (AEC-tr-4899) CONTRIBUTION TO THE STUDY OF THE PREPARATION OF BENZENE HEXACARBOXYLIC ACID OR MELLITIC ACID. H. Brusset and A. Uny. Translated by L. M. Ferris (Oak Ridge National Lab., Tenn.) from Bull. soc. chim. France, 565-7(1951). 8p.

The preparation of mellitic acid starting with phthalic acid and its formation in the oxidation of wood charcoal in liquid media are described. The preparation of mellitic acid starting with tetrachlorophthalic acid was re-examined and the method extended to the tetrabromo and tetraiodo derivatives. The oxidation of wood charcoal by nitric acid in the presence of a catalyst was studied. (auth)

7526 (CEA-tr-R-1403) EFFET ISOTOPIQUE CINETIQUE AU COURS DES REACTIONS D'ECHANGE DU DEUTERIUM ET DU TRITIUM DANS L'AMMONIAQUE LIQUIDE. (Isotope Kinetic Effects in the Course of Exchange Reactions of Deuterium and Tritium in Liquid Ammonia). F. S. Yakushin (Iakouchine) and A. I. Shatenshtein (Chatenstein). Translated into French from Kinetika i Kataliz, 1: 489-95(1960). 18p.

H^2F (or H^3F) or deuterated (or tritiated) 2-acetonaphthone is reacted with NH_3, and it is found that the D-H isotopic exchange proceeds 1.9 to 2.2 times as fast as the T-H exchange. The mechanism governing the relative exchange rates (the "isotope kinetic effect") is compared to the mechanism involved in the metallization of aromatic compounds by alkali metals. (T.F.H.)

7527 (CEA-tr-R-1415) PROPRIETES PHYSICO-CHIMIQUES DU TRIFLUORURE DE CHLORE. (Physico-Chemical Properties of Chlorine Trifluoride). Yu. D. Shishkov and A. A. Opalovskii. Translated into French from Uspekhi Khim., 29: 760-73(1960). 48p.

Methods for preparing ClF_3, the most reactive known halogen fluoride, are described, and the chemical and physical properties of ClF_3 are detailed. Some uses of ClF_3 are discussed. (T.F.H.)

7528 (CEA-tr-X-428) OXYDATION A HAUTE TEMPERATURE DU ZIRCONIUM PUR ET DE SES ALLIAGES DANS L'OXYGENE SEC. (Oxidation of Zirconium and its Alloys at High Temperatures in Dry Oxygen). Yotaro Murakami, Hirozo Kimura, and Keikichi Inoue. Translated into French from Suiyokaishi, 13: 587-90(1958). 24p. (Includes original, 4p.).

The volumetric method was used to study the oxidation of Zr and its alloys in dry oxygen under atmospheric pressure at high temperatures. The parabolic rate law can be fitted to the data for Zr. The calculated activation energy was 30,400 cal/mole. The oxidation reaction was reduced by additions of Sn and Ge. Nb appeared to improve the strength at elevated temperatures without reducing the oxidation resistance. (auth)

7529 ACTIVATION ENERGY OF THE MANGANESE DIOXIDE CATALYZED DISSOLUTION OF URANIUM DIOXIDE IN SULFURIC ACID MEDIUM. E. A. Kanevskii and V. A. Pchelkin. Atomnaya Energ., 11: 549-50(Dec. 1961). (In Russian)

In view of the widespread use of pyrolusite in the leaching of U from ores by sulfuric acid, the determination of the energy of activation of the $UO_2 + MnO_2 + 2H_2SO_4 \rightarrow UO_2SO_4 + MnSO_4 + 2H_2O$ reaction is of great interest. The effect of temperature on the dissolution process of UO_2 with $2\underline{N}$ H_2SO_4, using MnO_2 as oxidizing agent was investigated at temperatures ranging from 20 to 80°C. The UO_2 used for the experiments was prepared by the reduction of U_3O_8 with H_2 at 900°C, resulting in a material containing 98% U(IV) with respect to the sum of U(IV) + U(VI). It was found that at 20°C the dissolution depended on the time of contact. The reaction rate, log (UO_2) vs 1/T, followed an Arrhenius plot. From this the energy of activation was calculated to be 6 kcal/mole. In the reaction which involved 2 solid phases and the solution, steric factors play a retarding role. (TTT)

7530 STUDY OF THE PROPERTIES OF THE FLUORIDES OF CERTAIN POLYVALENT ELEMENTS BY POTENTIOMETRIC TITRATION IN NONAQUEOUS MEDIA. A. P. Kreshkov, V. A. Drozdov, E. G. Flasova, S. V. Vlasov, and Yu. A. Buslaev. Atomnaya Energ., 11: 553-4 (Dec. 1961). (In Russian)

While there are many reports on the nonaqueous titration methods of chlorides of the lower-valent elements, the behavior of the fluorides of the tetra-, penta- and hexavalent elements is not well studied. For this reason the higher fluorides of Mn, W, Nb, Ta, Zr and Ti were investigated, preparing them by direct fluorination at 110–120°C using an electrolyte of KF · 2HF – 40% HF. Steps were taken to prevent the hydrolysis of the solutions in the organic solvent. A Na methylate solution in methyl alcohol was used as titrating agent, carrying out the potentiometric titration with a calomel electrode with KCl in methyl alcohol and with a glass reference electrode. The highest fluoride of Zr was found to be insoluble in dioxane, methylethyl ketone, methyl alcohol and acetonitrile and thus could not be used, but the fluorides of Ti, Nb, Ta, Mo, and W were successfully titrated in methylethyl ketone solutions. An NaF deposit was found to precipitate at various stages of the process. The method may be used for the quantitative analysis of the above fluorides. (TTT)

7531 THERMAL DECOMPOSITION OF AMMONIUM–URANIUM PENTAFLUORIDE. N. P. Galkin, B. N. Sudarikov, and V. A. Zaitsev. Atomnaya Energ., 11: 554-5(Dec. 1961). (In Russian)

As known, NH_4UF_5 is subject to thermal decomposition into UF_4 and NH_4F; UF_6 is reduced by NH_3 at temperatures between 100 and 200°C forming NH_4UF_5 containing about 10% NH_4F. The thermoanalytical behavior of this product was further studied. Data indicated that endothermic effects occurred in the temperature ranges of 220 to 280, 320 to 360 and 420 to 450°C, resulting in a decrease of the weight of the material. The first weight loss amounts to 9.4% and it corresponds to the total elimination of the NH_4F, leaving only NH_4UF_5. Decomposition of this compound starts at 320°C; beyond 450°C only UF_4 is found. This behavior may be explained either by a difference in the bond strength of the individual NH_4F molecules or by a difference between the bond strength of ammonium and that of the fifth F ion. Further experiments indicated conclusively that the fifth F ion is more strongly bound to the U than the NH_4 ion; in the temperature range from 280 to 460°C the compound HUF_5 is stable although it is not known to exist in aqueous solutions. (TTT)

7532 CRYSTALLOGRAPHIC AND MAGNETIC STRUCTURE OF NIOBATES AND TANTALATES OF THE BIVALENT STATES OF TRANSITION METALS. Félix Bertaut, Lester Corliss, and Francis Forrat (Centre d'Etudes Nucleaires, Grenoble, France). Compt. rend., 251: 1733-5 (Oct. 24, 1960). (CEA-1972) (In French)

The structure of the compounds $Nb_2M_4O_9$ and $Ta_2M_4O_9$ (M being a transition metal) is related to that of corundum α Al_2O_3. The magnetic structure is described by antiparallel chains of spins M according tp $\frac{1}{3}$ $\frac{2}{3}$ Z↓ and $\frac{2}{3}$ $\frac{1}{3}$ Z↑. (auth)

7533 A MASS-SPECTROMETRIC STUDY OF THE VAPOR COMPOSITION OVER RARE EARTH OXIDES. S. A. Shchukarev and G. A. Semenov. Doklady Akad. Nauk S.S.S.R., 141: 652-4(Nov. 21, 1961). (In Russian)

The vapor composition of all rare earth oxides except thulium was investigated by evaporating a sample of oxide in an ion source equipped with a tungsten-rhenium thermocouple to measure the temperature. Ionizing potentials of 45 and 10 volts were used, and the maximum observed ion current was taken in each case. The vapor pressure of the main component was about 10^{-5} mm Hg std. There is a general tendency toward a decrease in the stability of the gaseous monoxide in going from La toward Lu, as evidenced by an increase in the ratio of M^+/MO^+. Elements having a valence state of two such as Eu and Yb show the maximum ratio of M^+/MO^+, and these oxides show an increased volatility. Gaseous molecules of CeO_2, PrO_2 and TbO_2 were observed. Molecules of CeO^+ and CeO_2^+ were observed on evaporating Ce_2O_3. Ions such as $M_2O_3^+$ or polymeric ions such as $(MO)_n$ were not observed in any case. (TTT)

7534 ISOTOPIC EXCHANGE BETWEEN O_2^{18} AND FUSED $Na_2WO_4^{16}$. Vikt. I. Spitsyn, V. G. Finikov, and G. N. Zykova (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 668-9(Nov. 21, 1961). (In Russian)

Fused Na_2WO_4 having a normal isotopic composition was contacted at 720, 745 and 764°C with oxygen containing 1.360 at. % O^{18}. The exposed area of the salt was 4 × 0.5 cm with sample weights of 1.0, 4.4 and 7.4 grams of Na_2WO_4. An activation energy of 38.4 kcal/mol was found from the formula $V = N_q \exp(-E/RT)$, where V is the reaction rate in molecules cm^{-2} sec^{-1}, and N_q is the number of collisions with the surface in molecules cm^{-2} sec^{-1}. Reaction rate constants were calculated from the formula $Kt = \ln 100/(100-\alpha)$, where K is the reaction rate constant, t is the time and α is the degree of exchange in percent. The apparent activation energies were found to be 30.6, 22.7 and 13.2 kcal/mol for the 1.0, 4.4 and 7.4 gram samples. Extrapolation to an infinitely thin layer gave an activation energy of 33.5 kcal/mol. (TTT)

7535 INTERNATIONAL CONFERENCE ON CHEMICAL PHYSICS OF NONMETALLIC CRYSTALS, HELD AT THE NORTHWESTERN UNIVERSITY, EVANSTON, ILLINOIS, U.S.A., AUGUST 28-31, 1961. J. Appl. Phys., 33: Suppl., 251-518(Jan. 1962).

Forty-five of the conference papers are included. Thirteen papers have been abstracted separately, 8 in NSA and 5 in RDA. The 32 papers not abstracted separately include information on the quantum theory of nonmetallic crystals, characterization of point defects in crystals, equilibrium properties of dilute solid solutions, and kinetic methods that characterize point defects. (P.C.H.)

7536 BAND THEORY, VALENCE BOND, AND TIGHT-BINDING CALCULATIONS. Per-Olov Loewdin (Uppsala Univ. and Univ. of Florida, Gainesville). J. Appl. Phys., 33: Suppl., 251-80(Jan. 1962).

In the theory of the electronic structure of crystals, the fundamental features of the electron theory, valence bond method, and tight-binding approximation are reviewed. The band theory is studied on the basis of the Hartree-Fock scheme, and the Bloch functions are formed by a projection technique. The main methods for calculating Hartree-Fock functions in a solid are briefly discussed. The advantages and disadvantages of the band theory and the valence bond method are emphasized, and special attention is paid to the correlation error. In connection with the tight-binding approximation, the importance of the continuum part and of the approximate linear dependencies is stressed. It is shown that a complete orthonormal set of translation connected atomic orbitals may be constructed as a convenient basis for this approach. The implication of the virial theorem in interpreting the cohesive properties of the ionic crystals is further emphasized. Some recent refinements of band theory are then discussed. It is shown that a large part of the correlation error can be removed by permitting different orbitals for different spins. This leads to a scheme intermediate between band theory and valence bond method and, by means of a single parameter, an essential lowering of the energy curve and the correct asymptotic behavior for separated atoms or constituents can be obtained. The band theory can be further refined and connected to the exact solution of the many-electron Schrödinger equation of the crystal by means of an extension of the self-consistent-field scheme, utilizing the so-called reaction operator here exactly defined by means of a simple partitioning technique. The various types of self-consistent field theories are finally compared. (auth)

7537 SOLID-STATE PERTURBATIONS OF NUCLEAR QUADRUPOLE COUPLING CONSTANTS. Richard Bersohn (Columbia Univ., New York). J. Appl. Phys., 33: Suppl., 286-9(Jan. 1962).

The cause of the shifts in quadrupole coupling constants between the gas and solid phases and between equivalent positions in a symmetrical polysubstituted molecule was investigated. An assignment of quadrupole resonance frequencies to positions in the unit cell of 1,3,5-trichlorobenzene is made on the basis of the calculated electric field. There is agreement with the true assignment and with the magnitude of shifts due to external electric fields. It was concluded that shifts in the resonance frequencies of nuclei at equivalent positions are due mainly to crystalline electric fields. Part of the shift between gas and solid phases is ascribed to zero-point torsional oscillations of the molecule. (auth)

7538 NUCLEAR QUADRUPOLE RESONANCE AND BONDING IN SOLID LAYER TYPE METAL HALIDES. R. G. Barnes, S. L. Segel, and W. H. Jones, Jr. (Ames Lab., Ames, Iowa). J. Appl. Phys., 33: Suppl., 296-302 (Jan. 1962). (IS-353).

Pure nuclear quadrupole resonance spectra are reported for halogen nuclei in a number of metal halides crystallizing in layer structures of the CdI_2 or related types. Because of the extreme smallness of the quadrupole coupling constants, particularly in the case of the dihalides, the possible appropriateness of a purely ionic model to account for the electric field gradients was investigated. Detailed calculations of the ion-lattice field gradient were made for a number of compounds representing several types of infinite-layer structure. In no case is the coupling due to the ion-lattice alone sufficient to explain the observed interactions. In fact, comparison with the experimental data suggests that empirical values of the antishielding factor γ_α about 3–5 times smaller than the theoretical values are appropriate to account for the ion-lattice contribution to the coupling. Covalent bonding between the metal and halogen layers involving only small departures from pure p-bond configurations at the halogens can account for the experimental results. Taking the ion-lattice gradient into account causes, in general, a small increase in the values of s hybridization needed in the covalent bond model. (auth)

7539 EFFECTS OF IONIZING RADIATIONS ON ALKALI HALIDES CONTAINING DIVALENT IMPURITIES. W. Hayes (Clarendon Lab., Oxford). J. Appl. Phys., 33: Suppl., 329-31(Jan. 1962).

Alkaline earth impurities introduce hole traps into KCl and KBr. Holes of the type X_2^- (X is a halogen) with (100) orientation are observed after x irradiation at 195°K, and are a source of anion vacancies. Iron group ions behave as electron traps in NaF and LiF. (auth)

7540 ELECTRON SPIN RESONANCE OF POINT DEFECTS IN CaF_2. B. Bleaney (Clarendon Lab., Oxford). J. Appl. Phys., 33: Suppl., 358-9(Jan. 1962).

Three possible mechanisms of charge compensation in CaF_2 are discussed. X irradiation of a CaF_2 crystal doped with thulium, which gives rise to an isotropic ESR spectrum, and the hydrolysis of CaF_2 are discussed. The spectra of Tm^{2+} and Yb^{3+} are compared. (P.C.H.)

7541 NONSTIOCHIOMETRY AND LATTICE DEFECTS IN TRANSITION METAL HYDRIDES. G. G. Libowitz (Atomics International, Canoga Park, Calif.). J. Appl. Phys., 33: Suppl., 399-405(Jan. 1962).

The relationships between equilibrium hydrogen pressure, hydrogen content, and temperature were derived for nonstoichiometric transition metal hydrides from both statistical mechanical and thermodynamic considerations. By comparing the derived equations with experimental pressure-composition isotherms, the type of lattice defect causing deviations from stoichiometry as well as the energies of defect formation and interaction can be calculated. This was done for uranium and palladium hydrides. The energies obtained were 69 kcal/mole for the vacancy formation energy, and 4.4 kcal/mole for the attractive vacancy interaction energy in uranium hydride. The corresponding energies in palladium hydride were 58.0 kcal/mole and 0.35 kcal/mole. The derived relationships are of general applicability to any nonstoichiometric binary compound which is deficient in the volatile component. (auth)

7542 ON THE STRUCTURE AND RELATED PROPERTIES OF THE OXIDES OF PRASEODYMIUM. L. Eyring (Arizona State Univ., Tempe) and N. C. Baenziger. J. Appl. Phys., 33: Suppl., 428-33(Jan. 1962).

The structures of praseodymium oxide phases of composition $PrO_{1.83}$, $PrO_{1.81}$, $PrO_{1.78}$, $PrO_{1.71}$, and $PrO_{1.69}$ are discussed in terms of the structures of $PrO_{2.00}$ and $PrO_{1.50}$ (C and A types). The way in which the existence of these several stable structures are mirrored in the physical and chemical properties is discussed. (auth)

7543 PROPERTIES OF LITHIUM HYDRIDE-V VACANCY FORMATION, CAVITATION, AND LITHIUM PRECIPITATION IN IRRADIATED LITHIUM HYDRIDE. F. E. Pretzel, W. B. Lewis, E. G. Szklarz, and D. T. Vier (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 33: Suppl., 510-18(Jan. 1962).

Expansion of crystals and compresses of LiH containing up to 40% LiT was observed during exposure to tritium β particles at temperatures from −196 to 400°C. Lithium metal precipitation was observed by electron paramagnetic resonance in small samples of similar composition. The results of auxiliary measurements of optical absorption, electrical conductivity and diffusion, nuclear magnetic resonance, and x-ray lattice parameter were used to interpret the data. Expansion was primarily related to the introduction of vacancies into the LiH crystal lattice to accommodate the products of radiation damage and tritium decay, to permit the formation of bcc Li metal, and to produce cavities in the crystals at high temperatures. Radiation damage was quickly reversed at the lowest temperatures, and the primary defects observed were interstitial He^3 atoms and F centers. Warming to room temperature caused aggregation of the F centers and introduced vacancies which destroyed the interstitials. Periodic warming for observation further increased the net expansion to allow the formation of bcc Li metal. At higher storage temperatures, vacancy diffusion stabilized a portion of the defects produced by radiation damage with the net result that increased expansion, increased Li formation, and H_2 molecular species were observed in the crystals. The expansion rates in the temperature range of increasing radiation damage gave an activation energy consistent with that obtained for vacancy diffusion. An intercomparison of expansion and bcc Li formation at 23°C gave results consistent with the radiation-damage yield and with the formation of Li metal by a diffusion-controlled process. Above a 300°C minimum a second increase in expansion related to cavitation was observed. (auth)

7544 DETERMINING IONIZATION CONSTANTS FROM ION EXCHANGE EQUILIBRIUM MEASUREMENTS. O. D. Bonner, R. Jackson, and O. C. Rogers (Univ. of South Carolina, Columbia). J. Chem. Educ., 39: 37-9(Jan. 1962).

Discussion is given on the use of ion exchange equilibria measurements as a rapid and convenient method for estimating the ionization constants of acids having constants in the range 10^{-3} to 10^{-1} with an accuracy of about 10% for acids having the smaller ionization constant and ranging to perhaps a maximum of 20% for the stronger acids. The true ionization constant is calculated by one of two methods. When the use of solutions as dilute as 10^{-3} M is possible, activity coefficient corrections may usually be made by utilizing the Debye-Hückel equation for the ionized species and assuming the activity coefficient of the unionized acid to be near unity. Alternatively, for more concentrated solutions an extrapolation procedure is necessary. Results are given for chloro-, dichloro-, and trichloroacetic acid. (P.C.H.)

7545 SOLID-LIQUID EQUILIBRIUM. SYSTEMS OF LITHIUM HYDRIDE WITH LITHIUM OXIDE, CALCIUM HYDRIDE, TITANIUM HYDRIDE, AND ZIRCONIUM HYDRIDE. Charles E. Messer, John Mellor, John A. Krol, and Ira S. Levy (Tufts Univ., Medford, Mass.). J. Chem. Eng. Data, 6: 328-30(July 1961).

Solid-liquid equilibrium was investigated by the method of thermal analysis. The system $LiH-Li_2O$ was studied from 0 to 14 mole % Li_2O and the system $LiH-CaH_2$ from 0 to 37 mole % CaH_2. The other two systems were investigated only at 8.0 ± 0.3 mole % titanium hydride and zirconium hydride in LiH. In the $LiH-Li_2O$ and $LiH-CaH_2$ systems, eutectics were found at 654.3 ± 0.3°C and 9.3 mole % Li_2O and at 614.0 ± 0.3°C and 18.3 mole % CaH_2. In both systems the cooling run liquidus temperatures were lower than the warming run values. The eutectic temperatures from warming and cooling agreed in the CaH_2 system; in the Li_2O system, the warming run value was 3° ± 1°C higher. These differences are presumably due to relatively slow achievement of equilibrium during the melting and freezing processes. The differences between the liquidus temperatures of the mixtures with titanium and zirconium hydrides and those of the corresponding samples of LiH alone are tabulated. With one possible exception, the differences are zero within the experimental errors of temperature measurement. In the zirconium hydride runs, and in most of the titanium hydride runs, the hydrogen contents were high enough to

favor the existence of the metal–hydrogen systems in the relatively more ionic δ and γ phases, respectively. (P.C.H.)

7546 EFFECT OF OXYGEN UPON THE HEAT CAPACITY OF GADOLINIUM BETWEEN 1.3° AND 5°K. L. T. Crane (Ford Motor Co., Dearborn, Mich.). J. Chem. Phys., 36: 10-11(Jan. 1962).

A specimen of gadolinium was oxygenated and the heat capacity measured at three levels of oxygen content. The broad low-temperature anomaly previously reported by others was reproduced by the oxygenation. Entropy calculations show that the reported anomaly results from the magnetic ordering of the spin $^7/_2$ Gd^{3+} ions of the Gd_2O_3 molecules. (auth)

7547 CRYSTAL STRUCTURE OF CUPRIC FLUORIDE DIHYDRATE AT 298°K. S. C. Abrahams and E. Prince (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 36: 50-5(Jan. 1962).

A neutron determination of the crystal structure of cupric fluoride dihydrate at 298°K was made. The structure consists of puckered sheets of nearly square CuF_2O_2 groups, linked together by hydrogen bonds of 2.715 ± 6 A, with the sheets connected by longer Cu–F bonds to form distorted octahedra around the Cu^{2+} ions. Dimensions within the octahedra are, two Cu–O distances of 1.941 ± 5, two Cu–F of 1.898 ± 8 and two Cu–F of 2.465 ± 6 A. The long F–Cu–F axis is inclined at $7^1/_2$° from the normal to the plane containing the remaining CuF_2O_2 group of the octahedron. The Cu–O bonds bisect the H–O–H angle of 115.5 ± 0.4°. The O–H bond is 0.980 ± 7 A and the O–H...F angle is 164.9 ± 0.7°. The amplitudes of thermal displacement of the atoms along various directions are given. The nuclear scattering length of fluorine is revised to 0.529 ± 13 (10^{-12} cm). (auth)

7548 CRYSTAL AND MAGNETIC STRUCTURE OF CUPRIC FLUORIDE DIHYDRATE AT 4.2°K. S. C. Abrahams (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 36: 56-61(Jan. 1962).

A neutron diffraction study of $CuF_2 \cdot 2H_2O$ below the Néel point determined the crystal and magnetic structure. As compared with this crystal at 298°K, the long Cu–F axial bonds of the distorted octahedron around the Cu^{2+} ion are reduced in length from 2.465 ± 6 to 2.391 ± 4 A: the short Cu–F bond of 1.899 ± 6 A and the Cu–O bond of 1.945 ± 4 A are unchanged. The H–O–H angle is reduced from 115.5° at 298°K to 110.1 ± 0.4° at 4.2°K, and the O–H distance from 0.980 ± 7 to 0.959 ± 5 A. The amplitudes of vibrational displacement of the Cu, O, and F atoms at 4.2°K are about one-half that at 298°K: The hydrogen atoms have about the same motion, due to zero-point energy. The magnetic unit cell is identical with the nuclear cell, but the spin on the body-centered copper atom is antiparallel to that at the origin. The spin direction is very nearly along the c axis, although an alternative model with the spin along the long octahedral direction fits the magnetic scattering almost as well. The difference between the Néel temperature of 10.9° and that of 26°K at which the magnetic susceptibility is a maximum is consistent with the observed magnetic structure. The revised nuclear scattering length for fluorine of 0.529 × 10^{-12} cm found in the analysis of $CuF_2 \cdot 2H_2O$ at 298°K is in excellent agreement with the presently obtained experimental value of 0.534 ± 12. (auth)

7549 SELF-DIFFUSION OF LEAD-210 IN SINGLE CRYSTALS OF LEAD SELENIDE. Martin S. Seltzer and J. Bruce Wagner, Jr. (Yale Univ., New Haven). J. Chem. Phys., 36: 130-4(Jan. 1962).

Self-diffusion of Pb-210 in lead selenide was studied in an inert atmosphere as a function of temperature (over the range 400–800°C) and defect concentration introduced by doping. Diffusion measurements were performed on specimens of p-type PbSe containing 10^{18} holes per cc and on specimens doped with $^1/_2$ mole % Bi_2Se_3 to give n-type material with 5 × 10^{19} electrons per cc or $^1/_2$ mole % Ag_2Se which resulted in p-type material containing 10^{19} holes per cc. Experimental results show that doping with Bi_2Se_3 decreased diffusivities as compared with undoped PbSe, whereas addition of Ag_2Se caused diffusion coefficients to be increased. The diffusion activation energies were 0.83, 1.61, and 0.55 ev for undoped PbSe, bismuth doped PbSe, and silver doped PbSe, respectively. From a consideration of the possible reactions for establishment of equilibrium between solid PbSe and the gas phase, the following equations were derived: $[Pb^{2+}\ (\text{interstitial})] \propto p_{Pb}/[\text{excess electrons}]^2$, $[\text{cation vacancy}] \propto [\text{excess electrons}]^2/p_{Pb}$, where the value of p_{Pb} is to be treated as a constant under the conditions of this experiment. From a consideration of the point defects introduced by doping and an evaluation of diffusion data applied to the above equations, it is concluded that Frenkel defects predominate in lead selenide and that diffusion of lead in this compound occurs predominantly by an interstitial mechanism under these conditions. (auth)

7550 ABSORPTION AND SELF-LUMINESCENCE SPECTRA OF Cf^{3+} ($5f^9$). John G. Conway (Univ. of California, Berkeley), John B. Gruber, E. Kenneth Hulet, Richard J. Morrow, and Ralph G. Gutmacher. J. Chem. Phys., 36: 189-90(Jan. 1962). (UCRL-9654)

The absorption and self-luminescence spectra of Cf^{3+} ($5f^9$) in $LaCl_3$ were observed between 3000 and 8500 A. Several of the observed groupings indicate a small crystal-field splitting compared with the spin-orbit splitting. As the basis for a tentative assignment of the reported spectra, a perturbation calculation was made on the LSJ levels of the ground multiplet, H^6_J, where $H^6_{15/2}$ is the ground level. If it is assumed that ζ = 4000 cm^{-1} and F_2 = 300 cm^{-1} for Cf^{3+}($5f^9$), a theoretical energy spectrum in reasonable agreement with that observed is obtained for the lowest levels. (auth)

7551 ABSORPTION SPECTRUM AND ZEEMAN EFFECT OF Am^{3+} IN $LaCl_3$. John B. Gruber and John G. Conway (Univ. of California, Berkeley). J. Chem. Phys., 36: 191-3(Jan. 1962). (UCRL-9555(Rev.))

The polarized absorption spectrum and Zeemen effect of Am^{3+} in $LaCl_3$ was studied from 2000 to 8000 Å. In almost every instance the peaks or lines observed are sharp, completely polarized, and appear in definite groupings. For the particular point symmetry C_{3h} forced electric-dipole-transitions are observed from F^7_0 to the excited crystal-field-split sublevels $\mu = \pm 2$ and 3 of J levels greater than one. (auth)

7552 THE ELECTROCHEMICAL BEHAVIOR OF URANIUM. John W. Ward and James T. Waber (Los Alamos Scientific Lab., N. Mex.). J. Electrochem. Soc., 109: 76-81(Feb. 1962).

The potential behavior of uranium was studied in both oxidizing and nonoxidizing media. A low critical anodic current and a very high critical potential for passivity were observed. In the presence of oxygen especially interesting behavior was noted. Oxygen, while passivating the corroding electrode, was reduced to form hydrogen peroxide. At steady state the potential of the passive electrode was found to be slightly more active than that

for the reversible oxygen-peroxide couple. Under these conditions, changing the partial pressure of oxygen caused potential shifts in accordance with the Nernst equation. (auth)

7553 DISSOLUTION OF ZIRCONIUM IN HCl-METHANOL. J. R. Aylward and E. M. Whitener (Phillips Petroleum Co., Idaho Falls, Idaho). J. Electrochem. Soc., 109: 87-91(Feb. 1962).

The dissolution of zirconium in HCl–methanol was studied potentiostatically as a function of HCl concentration and temperature. At low overvoltages the reaction is activation controlled and the rate independent of HCl concentration. In this region preferential grain boundary attack results in etching and separation from the electrode of finely divided particles of α-zirconium. At overvoltages above 0.5v a limiting current density is observed and the metal surface electropolished at HCl concentrations above 1.5M. The current for electropolishing decreases with increasing HCl concentration. The energy of activation at overvoltages of 0.0 and 1.0v (corrosion and electropolishing reactions) was found to be 16.5 and 7.7 kcal/mole, respectively. (auth)

7554 CHEMISTRY OF THORIUM. PART I. AMINO DERIVATIVES OF THORIUM(IV) CHLORIDE. Sarju Prasad and Suresh Kumar (Banaras Hindu Univ., India). J. Indian Chem. Soc., 38: 840-2(Oct. 1961). (In English)

The amino derivatives of thorium(IV) chloride were prepared by the action of $ThCl_4$ on some aromatic primary (mono- and di-) amines; their properties were studied and structures discussed. Data are tabulated. (auth)

7555 LIQUID SCINTILLATORS. IX. SYNTHESIS OF SOME ARYL SUBSTITUTED PHENANTHRENES AND DIHYDROPHENANTHRENES, AND RELATED p-TERPHENYLS AND p-QUATERPHENYLS. Stephen P. Birkeland, Guido H. Daub, F. Newton Hayes, and Donald G. Ott (Univ. of New Mexico, Albuquerque and Los Alamos Scientific Lab., N. Mex.). J. Org. Chem., 26: 2662-7(Aug. 1961).

2-Phenylphenanthrene and 2-(4-biphenylyl)phenanthrene, synthesized via the corresponding 2-aryl-3,4-dihydrophenanthrenes, were converted to the related 2,2′-bis(hydroxymethyl)- and 2,2′-bis(methoxymethyl)-p-terphenyls and p-quaterphenyls as well as the 3-aryl-5,7-dihydrodibenz[c,e]oxepins and 2-aryl-9,10-dihydrophenanthrenes. Analogous 2″,3′-disubstituted p-quaterphenyls, 5,7-dihydro-3,9-diphenyldibenz[c,e]oxepin, 9,10-dihydro-2,7-diphenylphenanthrene, and 2,7-diphenylphenanthrene were prepared starting with p-quaterphenyl-2″,3′-dicarboxylic acid. Evaluation of these compounds as liquid scintillation solutes was previously reported. (auth)

7556 METAL CHELATES OF ADENOSINE TRIPHOSPHATE. M. M. Taqui Khan and A. E. Martell (Clark Univ., Worcester, Mass.). J. Phys. Chem., 66: 10-15(Jan. 1962).

Stability constants of the 1:1 chelates of ATP with divalent metal ions, Cu^{2+}, Ni^{2+}, Co^{2+}, Mn^{2+}, Zn^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, and Ba^{2+} are reported at 25° and 0.1 ionic strength. The stabilities increase in the sequence: Ba < Sr < Ca < Mg < Co < Mn < Zn < Ni < Cu. The first and second hydrolysis constants and dimerization constants of copper(II)–ATP chelate are reported. (auth)

7557 THE BISMUTH–BISMUTH TRIBROMIDE AND BISMUTH–BISMUTH TRIIODIDE SYSTEMS. S. J. Yosim, L. D. Ransom, R. A. Sallach, and L. E. Topol (Atomics International, Canoga Park, Calif.). J. Phys. Chem., 66: 28-31(Jan. 1962).

The phase diagrams of the Bi–$BiBr_3$ and Bi–BiI_3 systems were determined. The experimental techniques included sampling at temperature, visual observations, conventional thermal analyses, and differential thermal analyses. The consolute temperatures (538° at 62 mole % Bi and 458° at 78 mole % Bi for the $BiBr_3$ and BiI_3 systems, respectively) are considerably lower than that of the $BiCl_3$ system (780° at 51 mole % Bi). The freezing point depressions of the metal-rich and salt-rich regions were analyzed. The salts dissolved in molten bismuth were found to have a cryoscopic number of 3. As in the $BiCl_3$ case, this effect can be explained by dissociation of BiX_3 solute or by reaction of BiX_3 with Bi to form the monohalide. In the case of the salt-rich regions the data did not fit a curve corresponding to one single mechanism over the entire liquidus. (auth)

7558 INTERCRYSTALLINE ENERGIES IN THE ALKALI HALIDES. Donald P. Spitzer (Univ. of Chicago). J. Phys. Chem., 66: 31-8(Jan. 1962).

Because of the basic importance of intercrystalline energies in determining properties of polycrystalline bodies, relative intercrystalline interfacial energies were determined in many alkali halide systems by measurement of the angles at which intercrystalline boundaries meet one another at equilibrium. The energies of boundaries between two crystals of the same phase were found to vary from 0.2 to 1.3, relative to the NaF intercrystalline energy. The relative energies of boundaries between two dissimilar crystals varied only from 0.7 to 1.0. From the equilibrium angles and the liquid-liquid interfacial energy in the system NaF(solid)–Te(liquid)–CsCl(liquid), the absolute energy of the average NaF grain boundary was determined to be 306 ± 15 ergs/cm^2. Generally, no correlation was found between intercrystalline energies and other basic parameters. (auth)

7559 THE ELECTRICAL CONDUCTIVITY OF SOLUTIONS OF METALS IN THEIR MOLTEN HALIDES. III. CERIUM–CERIUM TRICHLORIDE. H. R. Bronstein, A. S. Dworkin, and M. A. Bredig (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 66: 44-8(Jan. 1962).

The specific conductivity of solutions of cerium metal in molten cerium trichloride was redetermined by a method which avoids contact with ceramic material. The measurements were performed with two rigidly mounted parallel molybdenum electrodes immersed in the melt, which was contained in a molybdenum cup. The electrical conductivity of solutions of Cd metal in molten $CdCl_2$ was redetermined employing a capillary cell technique. These solutions were used as standards to obtain the cell constant of the parallel electrode cell. The conductivity of the Ce–$CeCl_3$ solutions at 855° was found to rise from 1.20 for the pure salt to 5.35 ohm^{-1} cm^{-1} at saturation (9.0 mole % Ce). This increase is ascribed to the presence of mobile electrons which may be in equilibrium ($Ce^{3+} + e^- \rightleftharpoons Ce^{2+}$) with divalent metal ions known to exist in other rare earth systems. Low conductivity results reported by previous investigators are attributed to a reaction between melt and ceramic container. (auth)

7560 ABSORPTION SPECTRA OF THE II, III, IV, AND V OXIDATION STATES OF VANADIUM IN LiCl–KCl EUTECTIC. OCTAHEDRAL–TETRAHEDRAL TRANSFORMATIONS OF V(II) AND V(III). D. M. Gruen and R. L. McBeth (Argonne National Lab., Ill.). J. Phys. Chem., 66: 57-65(Jan. 1962).

The II, III, IV, and V oxidation states of vanadium were characterized spectrophotometrically in LiCl–KCl eutectic in the range 300–2500 mμ and as a function of temperature

from 400–1000°. The spectra can be interpreted as arising from electronic transitions within the unfilled 3d shells of the ions. Ligand field considerations show that the low temperature (400°) spectra of V(II) and V(III) can be understood in terms of octahedral VCl_6^{4-} and VCl_6^{3-} complexes. At temperatures higher than 400°, the spectra of V(II) and V(III) undergo changes which can be interpreted in terms of octahedral–tetrahedral transformations involving the equilibria $VCl_6^{4-} = VCl_4^{2-} + 2Cl^-$ and $VCl_6^{3-} = VCl_4^- + 2Cl^-$. The V(IV) spectrum is not strongly affected by temperature. The V(V) spectrum is characterized by a single charge transfer band. (auth)

7561 THE NICKEL CHLORIDE–CESIUM CHLORIDE PHASE DIAGRAM. TETRAHEDRAL $NiCl_4^{2-}$ ION IN THE NEW COMPOUND Cs_3NiCl_5. E. Iberson, R. Gut, and D. M. Gruen (Argonne National Lab., Ill.). J. Phys. Chem., 66: 65-9(Jan. 1962).

The phase diagram of the nickel chloride–cesium chloride binary system was investigated by differential thermal analysis. The system exhibits two congruently melting compounds, $CsNiCl_3$ (m.p. 758°) and Cs_3NiCl_5 (m.p. 547°) as well as three eutectic points at 522, 541, and 747°. These correspond to the compositions 19, 27, and 55 mole % $NiCl_2$. The blue compound Cs_3NiCl_5 is isomorphous with Cs_3CoCl_5.[20] In these 3:1 compounds the transition metal ion is surrounded by four chloride ions in a tetrahedral arrangement. At 417°, Cs_2NiCl_5 decomposes in the solid state to CsCl and yellow $CsNiCl_3$ in which nickel is coördinated octahedrally. Qualitative considerations show that octahedral crystal field stabilization energies play an important role in determining phase stability in the CsCl–$NiCl_2$ system as well as in the other known CsCl–MCl_2 systems. The stereochemistry of the chlorine coördination polyhedra in complex chlorides of the transition elements is discussed in the light of crystal field theory and Jahn-Teller distortions. (auth)

7562 THE HEAT CAPACITY OF POTASSIUM HEXACHLORORHENATE(IV) FROM 7 TO 320°K. ANOMALIES NEAR 12, 76, 103, AND 111°K. ENTROPY AND FREE ENERGY FUNCTIONS. SOLUBILITY AND HEAT OF SOLUTION OF K_2ReCl_6. ENTROPY OF THE HEXACHLORORHENATE ION. R. H. Busey, H. H. Dearman, and R. B. Bevan, Jr. (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 66: 82-9(Jan. 1962).

Low temperature heat capacity data on K_2ReCl_6 are presented and the thermodynamic functions are tabulated. Of the four coöperative transitions exhibited by this compound with heat capacity maxima at 11.9, 76.05, 103.4, and 110.9°K, only the one at the lowest temperature is the result of a magnetic transition. It is estimated that an entropy of approximately R ln 2 is associated with each of the three remaining transitions. The solubility of K_2ReCl_6 in 0.01 M HCl is 0.1689 m at 25° and 0.0841 m at 0°. The standard heat of solution is 10,397 cal $mole^{-1}$ at 25°. The thermodynamic functions at 298.15°K (cal deg^{-1} $mole^{-1}$) are: $C_p^0 = 51.31$, $S^0 = 88.84 \pm 0.18$, $(H^0 - H_0^0)/T = 37.970$, and $-(F_0 - H_0^0)/T = 50.873$. The entropy and entropy of formation at 298.15°K of the hexachlororhenate ion are: $S^0(ReCl_6^-(aq.)) = 59.8$ cal deg^{-1} $mole^{-1}$ and $\Delta S_f^0(ReCl_6^-(aq.)) = 140.2$ cal deg^{-1} $mole^{-1}$. (auth)

7563 THE REACTIVITY OF HYDROGEN ATOMS IN THE LIQUID PHASE. II. THE REACTION WITH SOME ORGANIC SOLUTES. T. J. Hardwick (Gulf Research and Development Co., Pittsburgh). J. Phys. Chem., 66: 117-25(Jan. 1962).

The reactivity of a number of organic compounds with hydrogen atoms was measured in n-hexane solution at room temperature. The following classes of compounds react by addition of hydrogen only: esters, methylbenzenes, disulfides, conjugated or condensed aromatic compounds, vinyl monomers, and stable free radicals. Reacting by both addition and hydrogen abstraction are: aliphatic acids, aldehydes, ketones, alkynes, and alkyl (other than methyl) benzenes. Alcohols, ethers, and mercaptans are relatively inert. The effect of temperature on these reactions was studied, but the results are not easily interpreted. Absolute values for the rate constants at room temperature were obtained from a comparison with values previously established. (auth)

7564 ORDERING OF THE OCTAHEDRALLY COÖRDINATED CATION POSITION IN THE PEROVSKITE STRUCTURE. Francis Galasso and Wilda Darby (United Aircraft Corp., East Hartford, Conn.). J. Phys. Chem., 66: 131-2(Jan. 1962).

An x-ray analysis of compounds with the general formula $Ba(M^{3+}_{0.5}Nb^{5+}_{0.5})O_3$, where M^{3+} is a rare earth, indium, or iron ion showed that the critical percentage difference in radii necessary for ordering of the M^{3+} and niobium ions in the B sites of the perovskite structure lies between 7 and 17%. Of significance, this value found for ordering encompasses the 15% which was used as an indication of the maximum percentage difference in the sizes of atoms or ions involved in either solid solution formation or isomorphous substitution. (auth)

7565 THE CHEMISTRY OF URANIUM IN SURFACE IONIZATION SOURCES. Martin H. Studier, Eric N. Sloth, and Leon P. Moore (Argonne National Lab., Ill.). J. Phys. Chem., 66: 133-4(Jan. 1962).

Ions emitted from the surface of electrically heated filaments on which solutions of uranium had been evaporated were studied with a modified Bendix time of flight mass spectrometer. It was demonstrated that by control of the oxidizing and reducing agents on a heated filament and in the surrounding atmosphere the species of emitted ions can be controlled: Oxidizing agents (oxygen) → UC_2^+, U^+, UO^+, UO_2^+, UO_3^+, ← Reducing agents (carbon). The gaseous species UC_2^+ was observed. (auth)

7566 THE REACTION BETWEEN URANIUM HYDRIDE AND AMMONIA AT ROOM TEMPERATURE. Mohammed Alei (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 66: 145-8(Jan. 1962).

The reaction between NH_3 and UH_3 at room temperature was found to proceed very rapidly to form essentially a monolayer of nitride. Thereafter, the rate drops off rapidly according to a logarithmic rate law. The kinetic data are quite well interpreted on the basis of the theory which postulates chemisorption of a reactant as the rate-controlling step. (auth)

7567 CRYSTAL STRUCTURES OF SOME LANTHANIDE HYDRIDES. A. Pebler and W. E. Wallace (Univ. of Pittsburgh). J. Phys. Chem., 66: 148-51(Jan. 1962).

Hydrides of Pr, Nd, Sm, Tb, Dy, Ho, Er, Tm, Lu, and Y were formed and examined using x-ray diffraction techniques. The dihydrides of the several metals always were observed to be cubic. Appreciable contraction of the lattice occurs when PrH_3, NdH_3, or SmH_3 absorbs extra hydrogen. The PrH_3 and NdH_3 phases remain cubic to the highest hydrogen concentration attainable, whereas the Sm–H system undergoes a transformation such that the Sm ion cores are in a cph arrangement for hydrogen concentrations exceeding that corresponding to the formula $SmH_{2.53}$. Similar transformations are observed for the several heavy lanthanides studied and for yttrium, the range of stability of the

dihydride being, however, considerably less than that for the alloys based on SmH_3. The dependence of the lattice spacing on composition is discussed in terms of the presumed electronic nature of the lanthanide hydrides. The observed contraction of the dihydride lattice is consistent with the notion (suggested by their electrical and magnetic behavior) that the lanthanide hydrides are essentially saline in nature and the hydride ion is formed by absorption of electrons from the conduction band of the metal. (auth)

7568 THE USE OF A CATION-EXCHANGE RESIN TO STUDY THE CEROUS AND SULFATE ION COMPLEXES. L. A. Blatz (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 66: 160-4(Jan. 1962).

A precise method of using cation-exchange resins to study ionic equilibria in water solutions especially for the more difficult 3+ metal ion systems was explored. The sodium form of the cation-exchange resin Dowex-50 was used to obtain the complexing constants of cerous and sulfate ions at 25.04° and an ionic strength of 0.502 M. The values obtained for the association constants of $CeSO_4^+$ and $Ce(SO_4)_2^-$ are 56 ± 1 and 800 ± 40. There was no evidence for a third complex ion. During equilibration a constant cerous-ion concentration was maintained in the resin. A considerable study was made of the precision obtainable with this method. Two methods of extrapolation to zero sulfate-ion concentration are discussed. (auth)

7569 ELECTRODE POTENTIALS IN MOLTEN LITHIUM SULFATE–POTASSIUM SULFATE EUTECTIC. C. H. Liu (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 164-6(Jan. 1962). (BNL-5572)

The lithium sulfate–potassium sulfate eutectic (80% lithium sulfate by mole; melting point 535°) was shown to be an adequate molten solvent for electrochemical investigations at 625°. A procedure for preparing the eutectic melt was established. The silver(I)–silver(0) system was found to be a satisfactory reference electrode in this melt. The electrode systems, whose standard potentials were measured by direct potentiometry against the silver reference, are: copper(I)–copper(0), copper(II)–copper(I), palladium(II)–palladium(0), and rhodium–III)–rhodium(0). The Nernst equation was applicable in all cases. (auth)

7570 THE PREPARATION OF THORIUM OXIDE MICROSPHERES. II. ON THE MECHANISM OF SPHERE FORMATION. Yasaburo Yamazaki, Kenzo Yoshida, and Matsuo Komori (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 3: 936-41(Dec. 1961). (In Japanese)

Thorium hydroxide sol containing a predetermined amount of NH_4NO_3 was sprayed into isopropanol. The results revealed the content of NH_4NO_3 in the sol has a great importance for the formation of spherical gel particles. The spherical particle formation is affected with the content of NH_4NO_3 in the sol rather than the thorium content. The salt content must be higher than 0.5 g/cc. From the experiments it was supposed that the formation was related to the equilibrium of NH_4NO_3–H_2O-isopropanol system. The equilibrium was measured at 25°C, and a concentration region where three components separate into two liquid phases, the upper phase rich in alcohol and the lower rich in water and the sol, was found. Using this ternary system phase diagram, the mechanism of sphere formation was explained as follows. When sol is sprayed into alcohol, water and NH_4NO_3 diffuse into alcohol from the sol. By this diffusion, the sol reacts with alcohol in the following processes: small drops of the sol → emulsification and gellation of the sol drops → disappearance of the emulsion → spherical particles. (auth)

7571 ELECTRON SPIN RESONANCE ABSORPTION FOR POLYCRYSTALLINE SUBSTANCES. [PART] II. J. W. Searl (Northampton Coll., London), R. C. Smith, and S. J. Wyard. Proc. Phys. Soc. (London), 78: 1174-6 (Dec. 1, 1961).

Calculations were made of the electron spin resonance line shapes for polycrystalline substances showing uniaxial g-value anisotropy. The calculations were made for the Lorentzian and Gaussian line shapes of various line widths. Empirical rules are given for determining $g_\parallel$, $g_\perp$ and the line width from the experimental line shapes. Line shapes calculated to fit experimental curves from irradiated deuterium peroxide are given. (auth)

7572 THE BAND SPECTRUM OF ZrCl. P. K. Carroll and P. J. Daly (University Coll., Dublin). Proc. Roy. Irish Acad. A, 61: 101-7(Oct. 1961).

The spectrum of ZrCl was photographed under large dispersion from 2400 to 9600 Å. Three complex band systems were discovered in the regions 2840 to 2910 Å, 3630 to 3800 Å, and 4040 to 4150 Å. An extensive continuum was also observed under certain conditions and was tentatively assigned to $ZrCl_2$. (auth)

7573 THE CRYSTALLINE STRUCTURE OF SOLID ISOTOPES OF HYDROGEN. R. P. Ozerov, V. S. Kogan, G. S. Zhdanov, and O. L. Kukhto (Karpov Physicochemical Inst., Ukrainian SSR and Physicotechnical Inst., Academy of Sciences, Ukrainian SSR). Soviet Phys.-Cryst., 6: 507-8(Jan.-Feb. 1962).

The body centered tetragonal cells of solid hydrogen and deuterium were analyzed. From an analysis of the neutron diffraction patterns, it follows that the ortho- and para-molecules are arranged in an ordered fashion so that a tetragonal variant of the structure of the CsCl type forms. In some cases the solid hydrogen gave neutron diffraction patterns with a large number of lines at small angles. These patterns could be indexed on the assumption of a unit cell of the same syngony and with the ration c/a, but with double constants. The doubling of the constants can be explained by phenomena of ordering in the volume of eight unit cells, which is connected with special (not controlled) conditions of crystallization. However, the reason for the doubling can also be the orientation of the molecules in the lattice. For isotopes of hydrogen in the solid state, the existence of morphotropy can be assumed, connected with the presence of two types of molecules in different quantum states. (P.C.H.)

7574 X-RAY DIFFRACTION ANALYSIS OF POTASSIUM URANATES. L. M. Kovba and T. I. Churbakova (Moscow State Univ.). Zhur. Strukt. Khim., 2: 585-90 (Sept.-Oct. 1961). (In Russian)

Potassium uranates, $K_2O(3.1 \text{ to } 6.0)UO_3$, have a variable composition with infinite hexagonal uranyl oxide layers $(UO_2)O_2$. The potassium atoms and part of the uranium atoms are distributed between the layers forming a bond. A rhombic distortion of the structure is found in uranate compositions of $K_2O(5 \text{ to } 6)UO_3$. Aqueous potassium polyuranates are expressed by the formula $(K,H_2O)UO_2(O,OH)_2 \cdot nH_2O$. The variations in the composition of aqueous polyuranates are related to variations in the ratio of O and OH in uranium–oxygen media. (tr-auth)

7575 KOMPLEKSNYE SOEDINENIYA TRANSURANOVYKH ELEMENTOV. (Complex Compounds of Transuranium Elements). A. D. Gel'man, A. I. Moskvin, L. M. Zaitsev, and M. P. Mefod'eva. Moscow, Publishing House of the Academy of Sciences, 1961. 224p.

The chemistry of Np and Pu complex formation in aqueous solutions, the synthesis and properties of com-

plex compounds of tri-, tetra-, and hexavalent plutonium, and the formation of transplutonium-element complexes in solutions are discussed, as well as various methods of extracting and separating transuranium elements. Each chapter is supplemented by extensive bibliographies. (R.V.J.)

7576 CHLORINATION OF ZIRCONIUM OXIDE. Gordon Andrew Carlson (to Columbia-Southern Chemical Corp.). British Patent 885,955. Jan. 3, 1962.

A process is outlined for the rapid chlorination of ZrO_2 to produce pure $ZrCl_4$. Granules of a particle size of 10 to 100 mesh and of a bulk density of 25 to 100 lb/ft^3 (actual granule density 3.0 to 4.0) are prepared from ZrO_2 and carbon, both of a particle size below 150 mesh. A fluidized bed of these granules is established in an upward flow of Cl_2 at 600 to 800°C. The rate of Cl_2 introduction into the bed is 25 to 100 lb/hr per ft^2 of cross section of the chlorination furnace, and 1 to 25% of the solids in the bed are blown out with the evolved $ZrCl_4$ and may be separated therefrom. Methods are given for producing the granules. (D.L.C.)

Radiation Chemistry and Radiochemistry

7577 (AERE-M-742) HEAVY PARTICLE IRRADIATION EFFECTS DURING THE REACTION OF SOLIDS WITH GASES OR LIQUIDS. B. Cox (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1960. 10p.

The literature on the effects of heavy particle irradiations on the reactions between solids and gases or liquids is reviewed and discussed. In the light of this discussion some recommendations are made for the future investigation of the effects of heavy particle irradiation. (auth)

7578 (NYO-10022) THE EFFECT OF ELECTROPHILIC ADDITIVES ON THE RADIOLYTIC PRODUCTS OF ORGANIC CHAIN REACTIONS. Annual Report. E. I. Heiba (Little (Arthur D.) Inc., Cambridge, Mass.). Sept. 30, 1961. Contract AT(30-1)-2551. 38p.

Radiation-induced alkylation of propylene and isobutane adsorbed on silica and the transition metal oxides modified-silica gel has been investigated. The radiolytic yields of various products formed as a function of temperature and the hydrocarbon mixture content are recorded. Some of the factors governing radiolysis in the adsorbed phase are discussed. (auth)

7579 (PAN-259/CHR) γ-RADIATION INDUCED CHAIN REACTION OF OXYGEN REDUCTION IN THE AQUEOUS SYSTEM $O_2-Na_2So_3-NaOH$. Z. P. Zagorski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). July 1961. 20p.

In the continuation of polarographic studies on water solutions during gamma irradiation, the reaction of oxygen with sulfite in alkaline solution has been investigated. The reaction proceeds with radiation yield of up to 10^4 oxygen molecules consumed per 100 ev of absorbed energy. On the basis of the main and intermediate products investigation, of the influence of scavengers and of other features of the reaction, a mechanism of the reaction has been proposed, involving the termination step, which is closely connected with the radiolysis of water. (auth)

7580 (RRL-71) QUARTERLY REPORT [ON RADIATION CHEMISTRY], OCTOBER 1, 1961–DECEMBER 31, 1961. Fundamental Research No. 6041. (Mellon Inst. Radiation Research Labs., Pittsburgh). Jan. 8, 1962. Contract AT(30-1)-2310. 19p.

Radical yields for radiolysis of liquid n-pentane, n-hexane, and n-heptane were determined using ethylene-C^{14} and are tabulated. Possible reaction mechanisms for the radiolysis of liquid ethylene are discussed. Preliminary studies of the photolysis of ethyl iodide, vinyl chloride, and acrylonitrile are reported. Results of studies on the radiolysis of propyl chloride, ethyl bromide, and ethyl iodide at small conversions are summarized. Tables are given for the second-order structure of electron spin resonance spectra of organic radicals with from 0 to 9 equivalent nuclei. Studies of the radiation chemistry of deaerated aqueous isopropanol solutions are described briefly. The diffusivity of oxygen ions in pure vitreous silica was determined to be $D = 1.23 \times 10^{-2}$ exp $(-70{,}500/RT)$ at 925 to 1225°C. (D.L.C.)

7581 (TID-14630) RADIOCHEMISTRY RESEARCH. Progress Report, June 1, 1961–December 1961. (Kansas. Univ., Lawrence). Dec. 27, 1961. Contract [AT(11-1)-407]. 49p.

Research progress is reported on recoil tritium reactions in condensed and gas phases, reactions of fission products with organic solvents, possible hot atom reactions in nature, and radiation chemistry studies using labeled scavengers. The gamma radiolysis of cyclopropane in the presence of C_2H_5T scavenger is described. (M.C.G.)

7582 (TID-14661) TECHNICAL PROGRESS REPORT [ON CHEMISTRY], JANUARY 1, 1961–DECEMBER 31, 1961. Jack G. Kay (Illinois. Univ., Urbana). Contract AT(11-1)-891. 9p.

Investigations of the reactions of Pb^{212} recoiling from alpha-decay in the gas phase were continued to provide data on the production of volatile lead products in gases. The flash heating of lead foils in various gases was carried out while recording kinetic vacuum ultraviolet absorption spectra of the reaction species in the cell. The results of these experiments indicated that there were no detectable volatile compounds of lead formed by reaction of vaporized lead atoms with methane, argon, or carbon monoxide. In a study of the hot atom chemistry of tin in various crystals, the major effort was directed toward an initial determination of the distribution of the tin isotopes recoiling from neutron capture between the divalent and quadrivalent oxidation states. (M.C.G.)

7583 (CEA-tr-X-423) METHODE DE FABRICATION DU PHOSPHORE RADIOACTIF. (Method of Preparation of Radioactive Phosphorus). Translated into French from Danish Patent 88,777. Mar. 28, 1956. 7p.

A method is given for the preparation of radioactive P. Solid sulfur is first irradiated with neutrons in order to produce the phosphorus, and the phosphorus diffusing to the surface of the solid irradiated sulfur is dissolved in a homogeneous extractant, consisting of water and an organic humectant. The S is not dissolved, and the solution is concentrated by evaporation. The radioactive phosphorus solution is scoured in order to remove the organic humectant. (J.S.R.)

7584 RADIATION CHEMISTRY. John L. Magee (Univ. of Notre Dame, Ind.). Ann. Rev. Phys. Chem., 12: 389-410(1961).

The review on radiation chemistry is restricted to studies of the action of electron, gamma, x, and light particle radiations on molecular compounds. Emphasis is placed on the conceptual framework rather than current activity in various areas. More attention is given to the condensed state,

particularly the liquid state, than to the gaseous state because more effects are peculiar to high energy radiation here. 158 references are included. (P.C.H.)

7585 $Sr^{90}-Y^{90}$ BETA SOURCES FOR RADIATION CHEMISTRY STUDIES. W. S. Diethorn (Pennsylvania State Univ., University Park). Intern. J. Appl. Radiation and Isotopes, 12: 73-9(Dec. 1961). (In English)

The expected operating characteristics of two $Sr^{90}-Y^{90}$ irradiators designed for radiation chemistry studies of liquids and gases are discussed. Dose rates exceeding 1×10^6 rads/hr can be achieved in water and air with a sealed, 200 c $SrTiO_3$ source. Routine laboratory use of $Sr^{90}-Y^{90}$ irradiators is believed to be feasible. (auth)

7586 THE RADIATION INITIATED NITROSATION OF CYCLOHEXANE. P. R. Hills and R. A. Johnson (Wantage Research Lab., Berks, Eng.). Intern. J. Appl. Radiation and Isotopes, 12: 80-6(Dec. 1961). (In English)

The action of cobalt-60 gamma radiation on the nitrosyl chloride–cyclohexane system was studied. Small yields of cyclohexanone oxime were isolated, together with significant amounts of chlorocyclohexane, cyclohexanone, and adipic acid. It is believed that the oxime initially formed undergoes nitrosative de-oximation to form cyclohexanone which is subsequently oxidized to adipic acid. (auth)

7587 A NOVEL METHOD FOR PREPARING SMALL PARTICULATE RADIOACTIVE SOURCES OF HIGH INTENSITY FROM ATTAPULGITE CLAY. F. Sicilio, R. J. Klett, and J. A. Knight (Georgia Inst. of Tech., Atlanta). Intern. J. Appl. Radiation and Isotopes, 12: 141-2(Dec. 1961). (In English)

It was found that high intensity sources can be fabricated by evaporating to dryness a nearly saturated salt solution in contact with attapulgite clay, followed by firing at elevated temperatures. Simulated sources were prepared from Ag^{110} and Ce^{144}, with total loading greater than 8 milliequivalents per gram being effected. Any cationic radioisotope can be used. Nonencapsulated sources of this type would probably be suitable for flow-type reaction systems for radiation synthesis. In such systems, maximum efficiency of the radiation could be achieved, and combined heterogeneous catalysis radiation from the same material could be utilized. (P.C.H.)

7588 LIQUID SCINTILLATION COUNTING OF H_2S^{35}. B. E. Gordon, H. R. Lukens, Jr., and W. ten Hove (Shell Internationale Research Maatschappij N. V., Amsterdam). Intern. J. Appl. Radiation and Isotopes, 12: 145-6(Dec. 1961). (In English)

The cap of a Packard sample vial was modified to permit ready injection of the gas and yet prevent leakage. A series of such vials containing increasing volumes of H_2S^{35} was counted after various periods to determine the linearity of the calibration curve (a measure of both quenching and loss of gas to the vapor space) and the change of the curve with time. From the line obtained, it was obvious that loss to the vapor space is negligible and that quenching is no problem. Up to 12 hours may elapse with no significant loss of activity. (P.C.H.)

7589 A SIMPLIFIED METHOD FOR PREPARING I^{131}-LABELLED HIPPURAN. A. E. A. Mitta (Comisión Nacional de Energia Atómica, Buenos Aires), A. Fraga, and N. Veall. Intern. J. Appl. Radiation and Isotopes, 12: 146-7(Dec. 1961). (In English)

It was found possible to simplify the exchange method in the preparation of I^{131}-labeled o-iodohippurate so that the demands on time, skill, and facilities are substantially reduced. A method of preparation is given for which the radioactive yield is between 80 and 90%. The specific activity of the preparation is adequate as evidenced by clinical results obtained in several hospitals. (P.C.H.)

7590 THE REACTIONS OF ATOMIC CARBON WITH ETHYLENE. Colin MacKay (Yale Univ., New Haven), Paul Polak, Henry E. Rosenberg, and Richard Wolfgang. J. Am. Chem. Soc., 84: 308-9(Jan. 20, 1962).

Recoil C^{11} from a nuclear reaction was introduced into the gaseous reagent, and analysis was made for the C^{11} labeled radioactive products. The main products are highly unsaturated hydrocarbons. The high yield of acetylene is believed to result largely from the C—H bond insertion process as postulated for the alkanes. The cyclopropane observed is consistent with the previous hypothesis that a few per cent of the C atoms react by H pick-up from hydrocarbons to form $C^{11}H_2$. Data are tabulated for products obtained with pure ethylene, with oxygen added as a radical scavenger, and of runs containing a large excess of neon to thermalize the carbon atom before reaction. (P.C.H.)

7591 HYDROGEN FORMATION IN THE γ RADIOLYSIS OF ETHYLENE. P. Ausloos and R. Gorden, Jr. (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 36: 5-9(Jan. 1962).

The radiolysis of ethylene-d_2 and $C_2H_4-C_2D_4$ mixtures was investigated in the gas, liquid, and solid phases. The data indicate that hydrogen may be formed by two distinct molecular-elimination processes: $CH_2CH_2 \rightarrow CH_2C + H_2$ and $CH_2CH_2 \rightarrow CH \equiv CH + H_2$. The effect of xenon and pressure on the yields of H_2, HD, and D_2 in the gas-phase radiolysis of CH_2CD_2 was also investigated. The results for the $(^3P_1)$ Hg-sensitized and the 1237 A-photochemical decomposition were compared with those for radiolysis. (auth)

7592 FURTHER DETAILS CONCERNING THE RADIOLYSIS OF A CARBON TETRACHLORIDE–BENZENE MIXTURE. Nicole Gislon-Leary (Faculté des Sciences, Paris) and Serge May. J. chim. phys., 506-7(1961). (CEA-2061). (In French)

The yields in the radiolysis of $C_6H_6-CCl_4$ were studied by determining the contribution of each constituent to the radiolysis of the mixture. The contribution of the CCl_4 to the over-all phenomenon was evaluated by estimating the neutron activation of the chlorine fixed on diphenylpicrylhydrazyl during the radiolysis of the mixture. (P.C.H.)

7593 RADIATION CHEMISTRY OF WATER WITH PULSED HIGH INTENSITY ELECTRON BEAMS. A. R. Anderson and Edwin J. Hart (Argonne National Lab., Ill.). J. Phys. Chem., 66: 70-5(Jan. 1962).

The radiation chemistry of water, aqueous ferrous sulfate, hydrogen peroxide, and formic acid was studied using pulsed electron beams from the Argonne linear electron accelerator. With a pulse length of ~1.4 μsec and an electron energy of ~15 Mev, the dose rate received by the solutions during a pulse is equivalent to $\sim 2 \times 10^{22}$ ev ml^{-1} sec^{-1}. Under these conditions, $\sim 10^{-5}$ M hydrogen atoms (and hydroxyl radicals) are generated throughout the irradiated volume. All irradiations are monitored with the Fricke dosimeter, for which $G(Fe^{3+})$ is 11.4 ± 0.5 under these irradiation conditions. Preliminary studies with neutral water and with 0.8 N sulfuric acid solutions show that the initial yields of both hydrogen and hydrogen peroxide are about 80% higher in the acid solution but that, in each case, $G(H_2) = G(H_2O_2)$. Oxygen is not an initial product. Yields of hydrogen were measured in 0.8 N sulfuric acid up to 8 M hydrogen peroxide and up to 0.1 M in neutral solution. Hydrogen peroxide exerts a much stronger scavenging action in neutral than in acid solution. In each

case, but at different concentrations of hydrogen peroxide, the scavenging curves eventually coincide with those determined using Co^{60} γ radiation at a dose of $\sim 10^{17}$ ev ml^{-1} sec^{-1}. Although difficulties remain, these data are consistent with the transient existence of two reducing species designated as the solvated electron, e^-_{aq}, predominant in neutral solutions, and the H atom, predominant in acid solution. Hydrogen peroxide is 50 times more effective in suppressing hydrogen formation in neutral solutions than in 0.8 N sulfuric acid solutions. Some relative hydrogen atom (or e^-_{aq}) and hydroxyl radical rate constants consistent with the $G(H_2)$ and $G(H_2O_2)$ are reported. In contrast to the lower $G(Fe^{3+})$ obtained with ferrous sulfate, measurements with the formic acid dosimeter (0.01 M HCOOH, 0.001 N H_2SO_4, 0.001 M O_2) give the same yields as with Co^{60} γ radiation at much lower dose rates. $G(H_2O_2)$ for oxygen saturated neutral water is higher than that for γ rays. This greater yield can be explained on the basis of competing radical–radical reactions. (auth)

7594 CARBON-14-CONTAINING COMPOUNDS PRODUCED BY THE PILE NEUTRON IRRADIATION OF CYANOGUANIDINE. Thomas W. Lapp and Robert W. Kiser (Kansas State Univ., Manhattan). J. Phys. Chem., 66: 152-4(Jan. 1962).

An investigation has been made into the nature and relative amounts of the C^{14}-labeled products obtained from the dissolution in water of pile-neutron irradiated cyanoguanidine. Liquid scintillation counting was conveniently employed in the radioactivity determinations. Little activity was found in the form of CO, CO_2, CH_4, HCN, CH_3CN, HCHO, HC–OOH, urea, and methylhydrazine. Acetamidine, guanidine, and cyanoguanidine were found to contain 17, 13.5, and 41%, respectively, of the total activity induced in the original sample. A polymeric material, believed to be melamine, was found to contain approximately 13% of the total activity. Possible paths are suggested, in which cyanamide is considered to play an important role, leading from the crystal-stabilized species to the final products observed in solution. (auth)

7595 A CALORIMETRIC DETERMINATION OF THE OXIDATION YIELD OF THE FRICKE DOSIMETER AT HIGH DOSE RATES OF ELECTRONS. A. R. Anderson (Argonne National Lab., Ill.). J. Phys. Chem., 66: 180-2 (Jan. 1962).

A calorimetric determination was made of $G(Fe^{3+})$ for the Fricke dosimeter (0.001 M $FeSO_4$, 0.001 M NaCl, 0.8 N H_2SO_4, aerated), in order to provide dosimetry for the irradiation conditions applicable to certain chemical studies. $G(Fe^{3+})$ was determined as 15.2 ± 0.4 at an instantaneous dose rate of 5.7×10^{21} ev ml^{-1} sec^{-1}. The ferric yields determined at different instantaneous dose rates show that at dose rates $> 3 \times 10^{22}$ ev ml^{-1} sec^{-1} $G(Fe^{3+})$ decreases rapidly with increasing dose rate while below 10^{22} ev ml^{-1} sec^{-1} $G(Fe^{3+})$ is almost constant and approaches the accepted value for γ and electron irradiations at much lower dose rates. The calorimetric data indicate that the oxidation yield of the Fricke dosimeter can be represented adequately as 11.4 ± 0.5 ions per 100 ev. The calorimetry measurements and ferric yields are tabulated. (P.C.H.)

7596 TRITIUM-LABELED COMPOUNDS. VIII. CONFIRMATION OF THE POSITION OF THE TRITIUM IN D-GLUCOSE-6-t AND D-GLUCITOL-5-t. Lorna T. Sniegoski and Horace S. Isbell. J. Research Natl. Bur. Standards, 66A: 29-30(Jan.-Feb. 1962).

The radiochemical purity of D-glucose-6-t and D-glucitol-5-t was established by oxidation of the labeled compounds and determination of the radioactivity of the products. The results show that, in each instance, the tritium is present solely in the position cited. (auth)

7597 RADIATION LABELLING WITH CARBON-14 OF ALIPHATIC HYDROCARBONS. Fulvio Cacace and Angelo Guarino (Università, Rome and C.N.R., Rome). Nature, 186: 632-3(May 21, 1960). (CNEN-58)

A mixture of radioactive methane, propane, and xenon was irradiated to approximately 0.99×10^8 rads. The addition of xenon increased considerably the energy transfer from ionizing radiation to the hydrocarbon mixture. A mixture of ethylene, propane, butane, isobutane, pentane, isopentane, and hexane carriers were added, and gas chromatographic methods were used to separate the radioactive hydrocarbons in the irradiated sample. A fairly high percentage of methane radioactivity was found in the reaction products. The specific activity of the labeled hydrocarbons, except propane, was very high before dilution with carriers. Despite a high dose of gamma rays absorbed by the gaseous system, only a small amount of the radioactivity was found in unsaturated hydrocarbons. (P.C.H.)

7598 THE INFLUENCE OF OXYGEN ON THE PHOTOSENSITIVITY ON URANYL NITRATE SOLUTIONS IN TRI-n-BUTYLPHOSPHATE. Jerzy Brzeski (Inst. of Physical Chemistry, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 649-58(1961). (In English)

The influence of oxygen on the absorption spectrum of a 0.0215 M solution of uranyl nitrate in tri-n-butylphosphate irradiated with the monochromatic light was investigated. It was found that a photochemical reaction product which strongly absorbs light in the region of near ultraviolet is formed with the participation of oxygen, probably resulting in a peroxide compound of uranium (VI). In the irradiation in a de-oxygenated solution, uranium (IV) is formed and only insignificant changes occur. (auth)

7599 ELECTRON PARAMAGNETIC RESONANCE IN IRRADIATED CsCl. Floyd Hughes and James G. Allard (Naval Research Lab., Washington, D. C.). Phys. Rev., 125: 173-6(Jan. 1, 1962).

Two paramagnetic species were observed in CsCl after irradiation at low temperatures with 2-Mev electrons. One of these, an anisotropic, "hole"-type center, is not yet positively identified. The resonance signal from the other center has all the properties expected of the CsCl F center. The F-center parameters are $g = 1.984 \pm 0.001$, $A = 49.5 \pm 1.0$ gauss, and the envelope width at half maximum is approximately 800 gauss. The partially resolved hyperfine lines due to the nearest-neighbor Cs nuclei have an estimated width at half maximum of 17 ± 5 gauss. Due to the low signal-to-noise ratio only 38 of the expected 57 lines were observed. (auth)

7600 ELECTRON SPIN RESONANCE OF FREE RADICALS PRODUCED BY GAMMA IRRADIATION OF VARIOUS SUBSTANCES AT 4.2°K. Harvey N. Rexroad and Walter Gordy (Duke Univ., Durham, N. C.). Phys. Rev., 125: 242-7(Jan. 1, 1962).

Hydrogen atoms and other free radicals were produced by gamma irradiation of a number of substances at 4.2°K. Electron spin resonance was employed for detection and study of the free radicals within the solids at this temperature. It was found that strong electron spin resonance signals of H atoms could then be produced by dosages of 10^6 r or less in H_2O, HF, H_2, and CH_4, but no H atom signals could thus be produced in HCl, H_2S, NH_3, NaH, or LiH. The spacing of the hyperfine doublet was approximately 504 gauss for the H signals observed. An anomaly in the rela-

tive intensities of the H doublet for irradiated H_2O was detected and attributed to spin-spin interaction with a second free radical. It is concluded that in HF and H_2O the H atoms are formed from electron capture by the essentially ionic hydrogens rather than by removal of an electron from the molecule (ionization). Because this process does not require displacement of the atoms from their original sites in the lattice, it can take place in hard-frozen, rigid solids. In H_2, CH_4, and similar substances the production of H atoms requires the breaking of covalent bonds. This process, although initiated by ionization, appears to require also the displacement of the H from its original site in the lattice. (auth)

7601 ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF RADICALS FORMED IN IRRADIATED POLYPROPYLENE. Ya. S. Lebedev and Yu. D. Tsvetkov (Inst. of Chemical Physics, Academy of Sciences, USSR and Inst. of Chemical Kinetics and Combustion, Siberian Branch of the Academy of Sciences, USSR). Zhur. Strukt. Khim., 2: 607-9(Sept.-Oct. 1961). (In Russian)

Electron paramagnetic resonance spectra of radicals produced in polypropylene by Co^{60} γ rays or fast electrons were studied. Spectral data are given for a polycrystalline specimen irradiated at 77°C and cooled in vacuum to 25°C, a specimen kept in a vacuum for 5 hours at 25°C, and a specimen kept for 1.5 min after admitting oxygen. (R.V.J.)

7602 KERN- UND RADIOCHEMIE. GRUNDLAGEN · PRAKTISCHE METHODEN UND TECHNISCHE ANWENDUNG. (Nuclear and Radio Chemistry. Fundamentals, Practical Methods, and Technical Application). Roland Lindner. Berlin, Springer-Verlag, 1961. 378p. DM 49.80.

The book represents the contents of an introductory course given at the Guteborg Technische Hochschule. The topics discussed are atoms and their nuclei, radioactivity, nuclear reactions, nuclear chain reactions and nuclear reactors, radiation dangers and protection, radioactivity determinations, usual methods of radiochemistry, important radiochemical systems, reactor chemistry, and application of nuclear radiation and tracer isotopes in technology and science. (J.S.R.)

7603 IMPROVEMENTS IN AND RELATING TO THERMOPLASTIC COMPOSITIONS. John Cowper Barford and Noel Ernest Davenport (to B.X. Plastics Ltd.). British Patent 883,275. Nov. 29, 1961.

A process is given for preparing thermoplastic compositions of improved mechanical properties. A blend of a rubbery copolymer and a thermoplastic, hard inelastic resin in which the resin comprises 25 to 90 wt % of the blend is subjected to ionizing radiation to effect cross-linking and/or grafting of the rubber-resin constituents. The copolymer may be one of butadiene and acrylonitrile and the resin a copolymer of styrene and acrylonitrile. The blend may be irradiated after being shaped into a product. (D.L.C.)

7604 PREPARATION AND VULCANIZATION OF ARTICLES. (to Montecatini Societa Generale per l'Industria Mineraria e Chimica). British Patent 886,794. Jan. 10, 1962.

A process is given for preparing vulcanized articles which have improved properties for use as electric insulation, etc. The process comprises mixing polyethylene with a saturated amorphous copolymer of α-olefins at a temperature above the softening point of the polyethylene, adding a vulcanizing agent thereto, shaping the article from the mix, and finally vulcanizing the article. Preferably, an isotactic homopolymer of an α-olefin is also added to the mix prior to addition of the vulcanizing agent. The advantage of this process over previous processes is that the addition of the copolymer enables the shaping to be carried out at temperatures lower than the decomposition temperature of the vulcanizing agent and thus pre-vulcanization during the working stage is prevented. (D.L.C.)

7605 RADIOCHEMICAL SULFONATION REACTION (to Esso Research and Engineering Co.). British Patent 887,049. Jan. 17, 1962.

A process is given for the radiosulfonation of α olefins to produce sulfonic acid compounds of the formula $(RHCCH_2SO_3)_xM$, where M is an alkali metal, alkaline earth metal, or ammonium, and x is the valency of M. The process comprises irradiating a mixture of $RCH=CH_2$ and $M(HSO_3)_x$ with electromagnetic radiation of wavelength 10^{-4} to 10^2 A in a solvent in which bisulfite ionizes, until 2 to 50 Mr is absorbed. Heterogeneous or homogeneous systems may be used, and the mixture preferably contains ≥ 5 wt % olefins. The yield of sulfonated products is usually >20 mole % of the olefins. Two examples of the process are given. (D.L.C.)

Raw Materials and Feed Materials

7606 HOW THE HYDROXYL ION CONCENTRATION AFFECTS THE YIELD OF FLOTATED ZIRCONIUM IN THE ZIRCON ACTIVATION PROCESS. Janusz Biernat and Jan Łoziński (Univ. of Krakow). Przemysł Chem., 40: 602-3(Oct. 1961). (In Polish)

The influence of pH on the yield and content of $ZrSiO_4$ in the flotation concentrate was examined. The conditions under which the reaction of a zircon-rutile mixture leads to the highest zirconium yield at optimum $ZrSiO_4$ content are given. (auth)

7607 URANIUM RECOVERY AND PURIFICATION PROCESS AND PRODUCTION OF HIGH PURITY URANIUM TETRAFLUORIDE. Richard Hazel Bailes, Ray Smith Long, and Robert Russell Grinstead (to U. S. Atomic Energy Commission). British Patent 886,394. Jan. 3, 1962.

A process is outlined for separating uranium from a large variety of impurities to give a purified solution from which pure UF_4 can be obtained. The process comprises forming a solution containing >5 M chloride and the contaminated uranium, passing the solution through an anionic exchange resin to adsorb the anionic uranium chloride complexes and some of the impurities, washing the resin with >5 M HCl to remove the adsorbed impurities, and eluting the uranium with H_2O to yield an acidic UO_2Cl_2 solution of high purity. UF_4 may be precipitated from the solution by electrolytic reduction and addition of HF. (D.L.C.)

7608 EXTRACTION OF METAL VALUES. (to U. S. Atomic Energy Commission). British Patent 886,667. Jan. 10, 1962.

A multi-stage extraction system is designed for the extraction of uranium from aqueous feeds by a solution of tributyl phosphate in hexane. The advantage of the system is that the process is simplified and made more efficient by allowing phase separation in the last decanter only. (D.L.C.)

Separation Processes

7609 (BM-RI-5918) SEPARATING TANTALUM AND COLUMBIUM BY SOLVENT EXTRACTION: HF-HCl-

DIETHYL KETONE SYSTEM. Willard L. Hunter (Bureau of Mines. Albany Metallurgy Research Center, Ore.) and Kenneth B. Higbie (Bureau of Mines, Washington, D. C.). Mar. 1961. 13p.

A procedure is described for the separation of Ta, 99.4% pure, and Nb, 97.2% pure, by the selective transfer of Ta into diethyl ketone from a solution of 2 N HF and 1 N HCl. The relatively low acid concentration necessary for Ta transfer and the excellent selectivity of the system recommend its use for the separation of Ta and Nb from oxide mixtures obtained by chemical extraction of Geomines slag, or similar materials. (C.H.)

7610 (DP-601) EVALUATION OF "ADAKANE 12" FOR PUREX USE. P. J. P. Chastagner (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Contract AT(07-2)-1. 12p.

The physical properties of "Adakane 12" and its resistance to formation of zirconium ligands on degradation by gamma radiation and nitric–nitrous acid mixtures approached those of pure n-dodecane. (auth)

7611 (DP-653) PHYSICAL PROPERTIES OF URANIUM PROCESS SOLUTIONS. Robert S. Ondrejcin (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 13p.

Integral diffusion coefficients, viscosities, densities, and surface tensions were measured for the aqueous uranyl nitrate–nitric acid–aluminum nitrate system. The variation of the uranium diffusion coefficient was determined as as a function of uranium concentration, nitric acid concentration, and temperature. (auth)

7612 (HW-69631) DYNAMIC STUDY OF THE HANFORD NON-PRODUCTION FUELS REPROCESSING–TEST SHEAR. V. L. Hammond and C. E. Huck (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 17, 1961. Contract AT(45-1)-1350. 19p.

A dynamic study was conducted on a forty-ton hydraulic fuel element shear system for the Non-Production Fuels reprocessing program. The shear blade velocity and its relationship to hydraulic pressures was studied. The shear was operated at hydraulic pump pressures of 500 to 2000 psig under both load and no load conditions, and the maximum dynamic pressures at the end of the stroke ranged from 400 to 4000 psig with velocities from 60 to 105 in./sec. The data indicate that steady-state fluid flow equations can be used to determine the shear blade velocity prior to hitting the workpiece. (D.L.C.)

7613 (IDO-14575) ELECTROLYTIC DISSOLUTION OF NUCLEAR FUELS. PART II. NICHROME IN NITRATE SOLUTIONS. J. R. Aylward and E. M. Whitener (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 29, 1961. Contract AT(10-1)-205. 13p.

The electrolytic dissolution of Nichrome in nitrate systems is not complicated by the secondary passivation phenomenon observed in 304 stainless steel dissolution. The potential-current density curves in the transpassive region follow the Tafel equation ($\eta = a + b \log I$) where the slope (b) is equal to 0.038 volt. Under some conditions concentration polarization is present at high current densities (≥ 1 amp/cm^2) but can be eliminated in all practical dissolver solutions by operating at 70°C. (auth)

7614 (MCW-1452) METHODS OF SHORTENING THE HEATING CYCLE OF MAGNESIUM THERMITE BOMB REACTORS. R. F. Leifield, R. O. Sandberg, and S. W. Weidman (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). Jan. 31, 1962. Contract W-14-108-Eng-8. 30p.

At the Weldon Spring Feed Material Plant "dingot" uranium was produced in thermite bombs that were generally heated in electrical resistance furnaces for a period of 26 to 30 hours prior to electrical initiation of the reduction reaction. In order to increase the plant productivity it became necessary to develop a means of shortening the bomb furnace cycle, while at the same time maintaining high uranium metal yields and low hydrogen content. Several methods of shortening the bomb furnace cycle were investigated. The work included: experiments with a laboratory bomb that produces a 4-kg dingot and heat transfer calculations performed on an IBM 650 computer. Specific studies included the effects of: increasing the furnace temperature, increasing the thermal diffusivity of the bomb charge, decreasing the bomb diameter, and increasing the initial charge-temperature. Charge temperatures were increased through use of a consumable magnesium alloy wire resistance heater placed within the bomb charge. With this technique furnace heating periods of the 4-kg bomb were shortened to one-fourth those normally required. The yield and hydrogen content of the uranium product are acceptable. The technique was subsequently adapted to plant use in producing 3400-lb dingots, and furnace residence time was decreased to less than 15 hours. (auth)

7615 (ORNL-TM-35) CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, JULY 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Jan. 30, 1962. Contract [W-7405-eng-26]. 28p.

Thoria denitrator products from 0.04 to 0.066 N/Th ratio were dispersed into sols at N/Th radios of 0.11 to 0.19 and processed by the sol-gel technique to produce final compacted thoria products with little significant variation. Experimental results of H_2–CuO reaction in the helium purification work further substantiated the mathematical model. The elutions of uranyl sulfate loaded Dowex 21K with chloride apparently involved the diffusion of both the sulfate ions and the uranyl ions. The dejacketing of the NaK bonded SRE Core I fuel elements is proceeding satisfactorily with an average rate that has increased to 7 to 8 kg U/hr. The uranium slugs exhibited various degrees of camber and pitting. The disintegration-leaching of 3% U-graphite fuel by flowing 90% HNO_3 at 60°C is apparently superior to a batch-leach method. Attempts to use air bubblers to control the interface level at the bottom of a 2-in.-dia glass pulse column showed considerable loss of pulse amplitude, particularly in taller columns. An air operated diaphragm pump was designed, fabricated, and tested for use as a TrU facility process pump. A successful duplicate test was made calcining TBP-25 waste using the close coupled evaporator-calciner system. (auth)

7616 (AEC-tr-4982) CONCERNING THE MECHANISM OF EXTRACTION OF TETRAVALENT PLUTONIUM BY A PRIMARY ALKYL AMINE FROM SULFURIC ACID SOLUTION. V. M. Vdovenko, A. A. Lipovskii, and S. A. Nikitina. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from Radiokhimiya, 3: 396-402(1961). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract No. 32245.

7617 (CEA-tr-X-336) EFFET DU TRAITEMENT A DIVERSES TEMPERATURES, APRES ABSORPTION, SUR LE POUVOIR SELECTIF DU PHOSPHATE DE ZIRCONIUM UTILISE EN TANT QU'ECHANGEUR INORGANIQUE. (Effect of Treatment at Various Temperatures, After Ab-

sorption, on the Selective Power of Zirconium Phosphate Used as Inorganic Exchanger). G. Alberti and A. Conte ([Italy. Comitato Nazionale per le Ricerche Nucleari, Rome]). Translated into French by L. Roulet from p.3-7 of "Studi e Richerche Della Divisione Geomineraria, Vol. II." 1959. 8p.

The effect of treatment at various temperatures on the selective power of zirconium phosphate was studied after absorption of ion mixtures. Radioisotopes of strontium and cesium were used as the ion mixture. The ions were fixed on the zirconium phosphate in hydrochloric solution and eluted with HCl at 25 and 77°C. In a second series of studies the same quantities of Sr and Cs were fixed and the fixer column was heated at various temperatures for two hours and then eluted. The results show that separation is effected neither at room temperature nor at 77°C. A sharp separation, however, occurs when the exchanger is heated to 180°C. (J.S.R.)

7618 (KFK-tr-92) TRENNUNG VON TELLUR UND JOD MIT IONENAUSTAUSCHERHARZ. (Separation of Tellurium and Iodine with Ion Exchange Resins). M. Inarida. Translated into German by Peter Buriks (Kernforschungszentrum Karlsruhe, Ger.) from Nippon Kagaku Zasshi, 80: 399-400(1959). 39p.

This paper was previously abstracted from the French language and appears in NSA, Vol. 15, abstract no. 6057.

7619 SOLVENT EXTRACTION WITH QUATERNARY AMMONIUM HALIDES. Arthur M. Wilson, Lillian Churchill, Kenneth Kiluk, and Paul Hovsepian (Wayne State Univ., Detroit). Anal. Chem., 34: 203-7(Feb. 1962).

The solvent extraction of metal ions by quaternary ammonium halides dissolved in 1,2-dichloroethane is described. The extraction is dependent upon the ion association of the quaternary ammonium ion with labile chloro anionic complexes of Fe(III), Co(II), Zn(II), and Tl(III) or with the oxyanions of Hf(IV), Ta(V), and Mo(VI) in concentrated hydrochloric acid or lithium chloride. The effects of metal ion concentration, contacting time, and type of quaternary ammonium halide are investigated with the cobalt ion. Extractions of >50% for cobalt are possible only if the distribution ratio of the quaternary ammonium halide itself is very large. The value of the distribution ratio of the cobalt ion is dependent upon the quaternary ammonium ions' size, shape, and type of organic groups. An analogy between solvent extraction with quaternary ammonium halides and anion exchange of metal ions in concentrated hydrochloric acid is demonstrated. (auth)

7620 PHOTOLYTIC SEPARATION OF URANIUM FROM THORIUM, ZIRCONIUM, AND MANGANESE. U. K. Das, Balaram Sahoo, and D. Patnaik (Ravenshaw Coll., Cuttack, India). J. Indian Chem. Soc., 38: 843-4(Oct. 1961) (In English)

Separation of uranium from thorium, zirconium, and manganese was effected by a photochemical process using their sulfate solution. The role of alcohol on the recovery of uranium was investigated. Data are tabulated. (auth)

7621 SEPARATION OF Zr AND Hf BY EXTRACTION AS NITRATES. V. M. Kolikov and A. P. Perovskii. Zhur. Priklad. Khim., 34: 2605-9(Dec. 1961). (In Russian)

Zr and Hf separation in nitrate solutions of amyl acetate, butyl acetate and isoamyl alcohol was analyzed, and the dependence of Zr and Hf distribution coefficients on aqueous phase acidity and on Zr concentration was determined. Data on the microquantities of Zr in aqueous nitric acid solutions are used to determine the ratio of distribution and separation coefficients. (R.V.J.)

7622 IMPROVEMENTS IN ION EXCHANGE PROCESSES. (to New Consolidated Gold Fields Ltd.). British Patent 881,887. Nov. 8, 1961.

An ion exchange process for recovering metals from ores is outlined which can operate with a pulp in the specific gravity range of 1.4 to 1.5 without filtration or prior desanding. In this process, a layer of particulate ion exchange resin is caused to float on a body of pulp, and the pulp is agitated to provide good resin-pulp contact. A multicell apparatus is described for carrying out the process, and an example of the process is given in which uranium is recovered from South African ores. (D.L.C.)

7623 DEPOSITION OF BORON FROM FUSED SALT BATHS. Walter M. Weil. British Patent 886,466. Jan. 10, 1962.

A process is outlined for forming adherent boron coatings on metal surfaces by fused salt bath electrolysis of boron oxide. The electrolysis is carried out at 600 to 700°C with a bath consisting of only boron oxide and potassium fluoborate, the amount of boron oxide in the bath being <20 wt %, preferably between 2 and 15 wt %. The advantage of this bath over one containing potassium chloride or fluoride in addition to boron oxide and potassium fluoborate is longer electrolysis periods, thicker boron deposits, and lower temperatures. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

7624 (APEX-911) REMOTE HANDLING. Comprehensive Technical Report, General Electric Direct-Air-Cycle, Aircraft Nuclear Propulsion Program. R. F. Morand—R. R. Gehring, ed. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 13, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 63p.

General purpose equipment and procedures are described which were developed for the remote handling of irradiated aircraft power plants and associated subassemblies. At reactor operating cells, the operating personnel was shielded and the cells unshielded. The separate facilities were about one mile apart, connected to a locomotive turntable by means of a four-rail track system. Remote handling devices utilized in dismantling and inspection of radioactive power plants included an overhead manipulator, four wall-track-mounted manipulators, several master slave manipulators, periscopes, a tube-loading machine, and a core-removal fixture. General-purpose equipment such as manipulators and overhead cranes were augmented with special purpose tooling to satisfy the specific needs of the various power plants. General viewing was by direct-viewing shielded windows along the walls of the hot shop. The Flight Engine Test Facility (FET), was built to handle irradiated power plants mounted in aircraft. A self-propelled, shielded cab with manipulators was developed for working in the FET on nuclear power plants shortly after they were shut down. Photographs of the equipment are included. (C.H.)

7625 (CF-61-5-109(Suppl.3)) GAUGE CALIBRATIONS WITH DIFFERENT GASES. C. E. Normand (Oak Ridge National Lab., Tenn.). Jan. 5, 1962. Contract [W-7405-Eng-26]. 8p.

A study was made of the calibration of a Veeco RG-75 vacuum gage by the orifice method for hydrogen, helium, argon, nitrogen, and air at three different degrees of humidity. Determinations were made for orifice conductances and pumping speeds for each gas. Data from a representative run for each gas are plotted as calibration curves. Changes in humidity of the calibrating gas are considered to have no detectable effect on the sensitivity of the gages nor on the pumping speed. (B.O.G.)

7626 (DC-58-2-710) A SURVEY OF THE CURRENT KNOWLEDGE OF THE FILTERING OF GASEOUS STREAMS. Dale E. Johnson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 17, 1958. Contract AT(11-1)-171. 16p.

A brief survey of present data on gaseous reactor effluent filtering was made. Results indicated that information currently available was not an adequate basis for design of filters to be used in MTR and/or ETR effluents. A program for development of adequate filtering techniques is described. (J.R.D.)

7627 (DC-58-4-195) THE RADIATION ENVIRONMENT MEASUREMENT AND DATA REDUCTION TRAILER. F. N. Earle and J. Moteff (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 29, 1958. Contract AT(11-1)-171. 38p.

This equipment was designed for the more efficient extraction of information from existing experimental facilities. A description of the design and construction of the trailer is given followed by a description of the instrumentation systems to be used in some of the initial experiments together with some of the concepts involved in the selection of these components. (auth)

7628 (DC-59-7-114) HIGH TEMPERATURE ELECTRICAL CONNECTIONS. C. N. White (General Electric Co. Missile and Space Vehicle Dept., Burlington, Vt.). July 13, 1959. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contract AF 33(038)-21102. 64p.

A description and comparison of reasonable methods for making high temperature (above 500°F) electrical connections are presented. The program was primarily directed toward finding a suitable method of making connections for high-temperature amplifiers. There seems to be no single process or method of making high temperature electrical connections which can take the place of soft soldering. Arc fusing was chosen to be the most satisfactory method for making electrical connections in amplifiers currently being constructed. Some resistance welding and silver brazing was also done on sub-components before being assembled into the amplifier. (auth)

7629 (DC-59-7-129) THEORY AND PHOTOELASTIC EXPERIMENT, STRESSES AND DEFLECTIONS FOR THIN CYLINDRICAL SHELLS. D. R. Riley (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 14, 1959. Contract AT(11-1)-171. 36p.

Experimental results for a cylinder subjected to two diametrically opposite radial loads are correlated with theoretical analysis results. Stresses were measured using three-dimensional photoelastic techniques. Good correlation was obtained for deflections and bending stresses. (auth)

7630 (DC-59-10-101) P-103 CONTROL ACTUATOR PNEUMATIC SERVO VALVE DEVELOPMENT. L. C. White (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 1959. Contract AT(11-1)-171. 180p.

The evaluation and testing of the pneumatic servo valves which are used to control the P-103 dynamic and shim-scram actuators are described. (auth)

7631 (JPL-TR-32-196) RECIRCULATION OF A TWO-PHASE FLUID BY THERMAL AND CAPILLARY PUMPING. J. H. Laub and H. D. McGinness (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Dec. 8, 1961. Contract NASw-6. 14p.

A closed-cycle gas-supply system for gas bearings and gas-floated devices is described which eliminates mechanical pumps or compressors and uses instead thermal and capillary pumping action. A small quantity of a two-phase fluid of suitable thermodynamic characteristics, such as Freon, is recirculated in a closed system. The fluid is thermally vaporized in an evaporator, and the superheated vapor, after passing through the gas bearing, is condensed and returned to the evaporator by capillary action. The system is of special interest to space applications, because it can operate in a zero-g environment from solar or nuclear power sources, without conversion to electrical energy. (auth)

7632 (NYO-9666) STRESSES AT NOZZLE CONNECTIONS OF PRESSURE VESSELS. THE EFFECT OF PRESSURE AND EXTERNAL BENDING MOMENTS ON INSERT NOZZLE I. Quarterly Report, October 1, 1961–December 31, 1961. D. E. Hardenbergh and S. Y. Zamrik

(Pennsylvania State Univ., University Park). Jan. 10, 1962. Contract AT(30-1)-1874. 8p.

Results are presented from studies of stresses at nozzle connections of pressure vessels. The insert nozzle, designated as Nozzle I, is loaded separately with internal pressure and bending moments. These loadings are applied to the branch pipe of the nozzle. Dimensions of the nozzle are: ID of branch pipe, 5.761-in.; thickness of branch pipe, 0.432-in.; d/D = 0.320; and t/T = 0.432. Nominal stress ratio is 0.755 for s/S. Loadings are: internal pressure of 1000 psi, longitudinal bending couple of 250 kip in., and transverse bending couple of 250 kip in. (N.W.R.)

7633 (NYO-9807) ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report, July 1–September 30, 1961. Research Report 808-D804-R1. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Nov. 13, 1961. Contract AT(30-1)-2823. 10p.

The photodesorption of gases from metals by uv photons has been studied with a high sensitivity mass spectrometer. A program to develop low-temperature cathodes is underway to study hydrogen interactions at various surfaces. Preliminary results on the degassing characteristics of an all metal system have been obtained. (auth)

7634 (TID-13000) QUARTERLY PROGRESS REPORT NO. 61 [ON ELECTRONICS]. J. B. Wiesner, G. G. Harvey, and H. J. Zimmermann (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Apr. 15, 1961. Contracts AT(30-1)-1842; DA36-039-sc-78108; et al. 285p.

Research and development progress is reported on physical electronics, plasma dynamics, microwave spectroscopy, nuclear magnetic resonance and hyperfine structure, microwave electronics, molecular beams, modulation theory and systems, statistical communication theory, processing and transmission of information, physical acoustics, speech communication, communications biophysics, neurophysiology, neurology, circuit theory and design, sensory aids, and computer components and systems. (M.C.G.)

7635 (TID-13928) INTERIM REPORT ON THE DEVELOPMENT OF GAS-LUBRICATED BEARINGS FOR CLOSED-CYCLE, GAS-TURBINE ROTORS. M. W. Eusepi and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia). June 1961. Contracts [AT (30-1)-2585] and Nonr-2342(00). 52p. (I-A2049-14)

Progress is reported on the development of gas bearings for a closed-cycle gas-turbine rotor. Design and experimental data show the problems involved in the application of the bearings. The journal bearings and the thrust bearing for the rotor described are externally-pressurized without tilting pads. Each bearing surface is divided into three equal segments by appropriate grooving. Full loads have been successfully carried by the bearings under nonrotational tests. (auth)

7636 (AEC-tr-4973) RHEOLOGICAL PROPERTIES OF FLUIDIZED BEDS TRAVERSED BY GASES. K. Schuegerl, M. Merz, and F. Fetting. Translated for Argonne National Lab., Ill. from Chem. Eng. Sci., 15: 1-38(1961). 74p.

Flow curves were determined with a concentric cylinder viscosimeter in dependence on gas velocities for glass balls, quartz, aluminum, and cork meal of various grain sizes at rotary speeds from 0.3 to 486 rpm. It was possible to observe a flow limit and a minimum of the shearing stress in dependence on the angular velocity. For increasing gas velocities, the fluidized bed systems showed an intrinsically viscous character and it was possible to describe their flow curves by sine-hyperbolic functions. The dependence of the friction law or of the effective viscosity on the solid matter concentration was investigated by x ray absorption. The effective viscosity fluctuations of the fluidized bed yielded normal distributions. Their intensity depends on the gas velocity in a similar manner as does the intensity of the density fluctuations. (B.O.G.)

7637 (AEC-tr-4976) DETERMINING THE DENSITY DISTRIBUTION IN GASEOUS FLUIDIZED BED SYSTEMS BY X-RAYS. K. Schuegerl, M. Merz, and F. Fetting. Translated for Argonne National Lab., Ill. from Chem. Eng. Sci., 15: 39-74(1961). 76p.

The apparent density of the fluidized bed system consisting of a solid-gas mixed phase and the time fluctuations were measured by x ray absorption at five different levels over the flow impact base in dependence on flow velocity and grain types. From the frequency distribution, the median value of the density was determined as mean density and the most probable deviation, with reference to the mean density, as relative intensity of the density fluctuations. The mean density diminishes with rising flow velocity. The relative intensity of the density fluctuations decreases with rising flow velocity and increasing height over the flow impact base. A hollow cylinder immersed in the fluidized bed altered the mean density and the intensity of the density fluctuations only in the smaller fluidized bed apparatus. (B.O.G.)

7638 BASIC CHARACTERISTICS OF A LABORATORY DESIGNED FOR MEASURING VERY LOW ACTIVITIES. B. Grinberg and Y. Le Gallic (Centre d'Etudes Nucléaires, Saclay, France). Intern. J. Appl. Radiation and Isotopes, 12: 104-17(Dec. 1961). (In French)

The conditions which must be fulfilled by a laboratory which specializes in the measurement of very low activities (about 10^{-6} μc/g) and the spectrometric identification of radioactive impurities are defined. The aim sought is the greatest possible reduction of the detector background. From analysis and from experiments carried out it follows that simultaneous protection must be achieved against: cosmic rays — by electronic means and by absorption under specified conditions, contamination of materials — by rigorous selection, and ambient radiation — by the continuous supply of filtered air and in addition, in the case of α detectors, by the protection of these with the use of a strictly inactive gas. (auth)

7639 INCINERATION OF FECAL SPECIMENS FOR RADIOACTIVITY MEASUREMENT. Donald L. Buchanan and Lowell T. Sampson (Veterans Administration Hospital, West Haven, Conn.). J. Lab. Clin. Med., 59: 169-73(Jan. 1962).

An easily constructed, gas fired, laboratory incinerator is described which is capable of reducing stool specimens and other large organic samples to ashes of small volume. Complete combustion is achieved by surrounding the sample and its container by gas flames and then venting any distilled gases through an incandescent wire screen. The ashes are transferred to test tubes for measurement in a well scintillation counter. The method is considerably more sensitive than the counting of aliquots of homogenized feces and most of the unpleasantness of former methods is eliminated. Its chief use has been the quantitation of gastrointestinal hemorrhage with the use of Cr^{51}-tagged erythrocytes, but it has also been used successfully with Co^{60} cobalamine. (auth)

7640 BEARINGS FOR HIGH SPEED ROTORS. G. Gobert (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: Suppl. to No. 2, 39A-42A(Feb. 1961). (CEA-1804). (In French)

The results are given of various experiments which make possible the design of bearings such that the relative tangential velocity between static and dynamic parts is greater than 300 m/s for angular speeds greater than 3000 rps. (auth)

7641 ON THE HOT METALLURGY LABORATORY IN JAERI. I. STUDY FOR FUEL DEVELOPMENT, (8). Kiyoaki Taketani (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 3: 929-35(Dec. 1961). (In Japanese)

The design, construction, and operation of the hot metallurgy laboratory in the Japan Atomic Energy Research Inst. are described. The facility is mainly used for post-irradiation test of irradiated fissile materials and fuel elements from reactors. It has five unit cells, operation room, changing room, decontamination room, and so on. The shielding of these cells is composed of heavy concrete and lead glass windows withstanding 10,000 curie activity. The area of the unit cell is 8 ft by 8 ft and each cell has its own M-8 type manipulator and power manipulator traveling between all cells. Ventilation, monitoring, lighting, emergency power supply, and utilities in the laboratory are discussed. (auth)

7642 STATISTICS AND THE ESTIMATION OF DESIGN DATA. [PART] 1. A. N. Knowles (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Nuclear Power, 7: No. 69, 74-6(Jan. 1962).

A statistical method of making a reasonable estimate of design data from only a few tests is described. The elementary sampling theory for this method is also described. (N.W.R.)

7643 CONSTRUCTION OF A SMALL "OPEN" COBALT SOURCE FOR RADIOBIOLOGICAL INVESTIGATIONS. Zofia Tramer and David Shugar (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw and State Inst. of Hygiene, Warsaw). Nukleonika, 6: 667-74(1961). (In Polish)

Details are given for the construction of a 63-c Co^{60} source for work in the field of radiobiology and for some applications in radiation chemistry of biological compounds. The principal advantage of such a source, as compared to that of commercially available closed sources, is that irradiations are performed in the open so that it may be applied to almost any type of problem in radiobiology. A brief description is given of some of the research projects which were carried out with this type of source, as well as some of its advantages. (auth)

7644 X-RAY SPECTRUM FROM A PLASTIC WINDOW TUBE. Richard C. Palmer, William V. Willis, and Dearl K. Davis (Georgia Inst. of Tech., Atlanta). Phys. in Med. Biol., 6: 401-6(Jan. 1962).

The x ray spectrum from a plastic window tube operated at 150 kv and 15 ma was determined by means of scintillation spectrometry. Corrections for background, block time, energy resolution, and escape of K_x x ray of iodine were applied to the data. The peak intensity is obtained at 0.14 Å (90 kev). The characteristic x rays of the tungsten target were not distinguishable from the bremsstrahlung continuum. (auth)

7645 A HOLDER FOR RADIOCHEMICAL CENTRE STANDARD AMPOULES. R. E. Sear, E. Webb, and C. B. Ellis (London Hospital). Phys. in Med. Biol., 6: 453-5 Jan. 1962).

A holder is described for standard 10 ml ampules which provides for safe extraction of the radioactive liquid contents by means of a syringe. The design is based to some extent upon that of a similar device already described, but incorporates several modifications and improvements. (auth)

7646 ENHANCED HYDROGEN PUMPING WITH SPUTTER-ION PUMP. S. L. Rutherford and R. L. Jepsen (Varian Associates, Palo Alto, Calif.). Rev. Sci. Instr., 32: 1144-6(Oct. 1961).

The physical processes which give rise to enhanced hydrogen pumping and anomalous differences between steady-state and dynamic pumping speeds are investigated. Observations suggest that two factors of dominant importance in the pumping of hydrogen are cathode surface conditions, which affect the rate at which incident molecular hydrogen is adsorbed, and permeability of the bulk material to hydrogen diffusion. Surface conditions are strongly affected by oxide films and layers of adsorbed gas, while permeability is influenced by temperature, crystal sizes and orientations, impurities and defects, and stresses in the metal. Results also show that a dramatic enhancement of pumping speed is observed after the pump cathodes are cleaned in vacuum by sputtering with argon ions. Thus, the initial value of the residual pumping speed suggests that with sufficiently clean cathode surfaces most of the hydrogen pumping can occur by direct molecular contact. (N.W.R.)

7647 NEW TYPE FILTER FOR PREPARING AND FILTERING RECYCLED WATERS. Wolfgang Hett. Wasser, Luft u. Betrieb, 5: 63-7(Feb. 1961). (In German)

In a closed cooling water cycle with an open cooling tower, the possibility of contamination by air–water contact in the cooling tower itself must be considered. The design and performance of a candle rotary pressure filter system for use under such conditions is described. A diagram is shown for this system for two separate water cycles having a common desiccation of the cleaning sediment through a rotary pressure filter. (J.S.R.)

7648 LOOP TYPE GAMMA RADIATION FACILITY. (to Esso Research and Engineering Co.). British Patent 886,089. Jan. 3, 1962.

An apparatus is described for irradiating a substance with gamma rays in the absence of neutrons. The apparatus comprises an irradiation zone, a neutron-producing zone in a reactor, and a closed transfer loop running through both zones and containing a fluidized mass of finely divided solid material of high neutron absorption cross section. In operation, the fluidized solid is circulated through the reactor where it is activated and thence to the irradiation zone. An example of the use of the apparatus is given in which activated MnO_2 solid is used to induce the formation of cetyl sulfonic acid from cetane + SO_2 + O_2. (D.L.C.)

7649 IMPROVEMENTS IN OR RELATING TO LIQUID EVAPORATING APPARATUS. Michael Eric Morrish Davey, Eric James Thornthwaite, and Eric Handley Voice (to United Kingdom Atomic Energy Authority). British Patent 886,189. Jan. 3, 1962.

A liquid evaporating apparatus is designed which is suitable for concentration of radioactive waste liquids for storage. The apparatus comprises an upright tubular evaporating vessel with a liquid inlet at its lower end and a vapor outlet at its upper end, a heater surrounding the vessel, and an economizer in the form of a pipe helically coiled around the heater so that the liquid is preheated prior to its entering the evaporating vessel. (D.L.C.)

7650 IMPROVEMENTS IN STORAGE ARRANGEMENTS FOR RADIOACTIVE COMPONENTS. (to Babcock & Wilcox Co.). British Patent 886,294. Jan. 3, 1962.

A facility for storing radioactive components after use in a reactor is designed which eliminates the danger of stored fissile materials inadvertently achieving criticality. The facility comprises a chamber for containing a shielding liquid, means for suspending fissile components within the liquid, and guide means for permitting suspension only at predetermined safe locations. An embodiment of the facility is described for transfer of reactor fuel elements from reactors and storage. (D.L.C.)

7651 IMPROVEMENTS RELATING TO THE MEASUREMENT OF INTERLAYER SPACINGS BETWEEN FERROUS METAL LAYERS. James William Walley (to Associated Electrical Industries, Ltd.). British Patent 886,675. Jan. 10, 1962.

A method of measuring interlayer spacings between closely adjacent ferrous metal layers is described which can be used to check the spacing between a reactor pressure vessel and its reinforcement plates. A magnetizing force is applied between spaced points on the surface of the outer ferrous layer, and the elements of a magnetometer are located between the points so as to be deflected by the magnetic field. The magnetometer reading provides an indication of the spacing between layers. (D.L.C.)

7652 PHOTOGRAPHIC CAMERA HAVING IMPROVED KERR CELL SHUTTER ASSEMBLY. Alexander Edward Huston (to United Kingdom Atomic Energy Authority). British Patent 886,829. Jan. 10, 1962.

A high-speed camera having an electro-optical shutter of the Kerr cell type is designed which can operate at a framing rate above 2×10^6 per second and which has only a relatively low electrical energy consumption. The electrodes of the Kerr cell are connected across an inductance to form an undamped parallel resonant circuit. The means for energizing the circuit may comprise a valve having its anode connected to the circuit. (D.L.C.)

7653 IMPROVEMENTS IN OR RELATING TO EQUIPMENT FOR HANDLING DANGEROUS SUBSTANCES. Kenneth Winfield Bagnall and Daniel Stewart Robertson (to United Kingdom Atomic Energy Authority). British Patent 887,367. Jan. 17, 1962.

An apparatus for carrying out operations on toxic or radioactive substances comprises a circular gastight chamber with a turntable situated within. A window is provided in the wall of the chamber, and glove ports are provided in both the table and the base plate of the chamber. The table may be rotated to register the gloveports for transport of objects into or from the chamber. (D.L.C.)

7654 BLANKET DISPENSING DEVICE. Andre Chappellier (to Commissariat a l'Energie Atomique). British Patent 888,641. Jan. 31, 1962.

A device is designed for dispensing an emergency fire and accident blanket. The device comprises a metal chest containing a blanket folded in accordion fashion and openable from the bottom by a small pull on a string or rope. (D.L.C.)

7655 IMPROVEMENTS RELATING TO RADIANT ENERGY EMITTING DEVICES. (to Picker X-Ray Corp.). British Patent 888,677. Jan. 31, 1962.

A radiation device for use in medical therapy treatment is designed in which the problem of maintaining the collimating cone in the operative position is simplified. The head and cone of the device are formed with guide surfaces for guiding the cone into position, and the assembly for maintaining the cone in this position comprises a magnetic part in the head and an armature part made of magnetic material in the cone. Thus, the cone can be easily rotated relative to the head and held in place without a locking mechanism. (D.L.C.)

Heat Transfer and Fluid Flow

Refer also to abstracts 7991 and 8381

7656 (DC-58-3-147) DISPLACEMENTS AND STRESSES IN A CIRCULAR CYLINDER PRODUCED BY A PAIR OF EQUAL AND OPPOSITE LINE LOADS, AXIALLY DIRECTED. STRUCTURAL MEMO NO. 17. R. J. Dunholter (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 18, 1958. Contract AT(11-1)-171. 21p.

A series solution is obtained for the displacements and stresses in a simply supported circular cylinder subjected to a pair of equal and opposite line loads located on the generator $\Phi = 0$ and $\Phi = \pi$ and directed parallel to the axis of the cylinder. (auth)

7657 (DC-60-10-40) TEMPERATURE AND HEAT FLUX IN A LONG HOLLOW TUBE WITH AN EXPONENTIAL HEAT SOURCE. J. F. Heyda (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 1960. Contract AT(11-1)-171. 15p.

Employing the appropriate Green's function for a circular ring, temperature and heat flux distributions were obtained for a long hollow tube with an internal heat source of the form $e^{-\beta s}$, where s is the distance of any point in the tube wall from a fixed plane tangent to the exterior surface of the tube. (auth)

7658 (EURAEC-43) DESIGN AND ASSEMBLY OF A LOOP FOR EXPERIMENTS ON FLOW STABILITY AND DISTRIBUTION IN TWO-PHASE FLOW. Special Report No. 3. N. Adorni, I. Casagrande, L. Cravarolo, A. Hassid, M. Silvestri, and S. Villani (Centro Informazioni Studi Esperienze, Milan). Oct. 1960. Work Performed under United States-Euratom Joint Research and Development Program. Contract 002-59-11RDI. 63p. (CISE-R-26)

The dispersed flow pattern of two-phase flow is being investigated inside ducts simulating possible fuel element channels in order to determine which factors affect its stability and homogeneity. Physical and geometrical specifications of the experimental loop are described. The test section, main components, instrumentation, auxiliary purging system, gas and water supply, and support frame and construction procedure are discussed. Preliminary tests and method of operation are outlined. (M.C.G.)

7659 (HW-67151) LOCAL HEAT TRANSFER COEFFICIENTS IN A 19-ROD BUNDLE. J. G. Knudsen and J. M. Batch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 19, 1960. Contract AT(45-1)-1350. 38p.

By means of specially designed heat transfer probes, local heat transfer coefficients were determined in a 45-in. long rod bundle containing 19 rods. Various rods in the bundle contained "wire wrap" mixing devices. The cross sectional size of the test section was very close in size to the Mark I fuel element for the PRTR. Local coefficients

were determined with 40 to 60°F water flowing at approximately 70 gpm axially through the bundle. Five representative rods were studied at various positions 10.5 to 20.5-in. from the upstream end of the wire wraps which covered the middle 30 inches of the rods. Local coefficients were measured every 10 to 15 degrees around the rods. The probable error in the measured coefficients is ±5 to 10%. Local values of the temperature difference between surface and coolant were plotted for various tubes and longitudinal positions. Average circumferential coefficients for surfaces exposed to various channels were also plotted. Average, maximum, and minimum observed Δt's are shown. There was more variation of Δt on rods with wire wraps than on those without wraps. For wire wrapped rods the maximum coefficient was about twice the minimum while on the unwrapped rods the maximum was about 1.5 times the minimum. The experimental results can be extrapolated to conditions other than those of the experiments. There was a slight increase in the average coefficient on the rod as the fluid flowed past the wire wrap. However, at the wire itself the point coefficient was low as evidenced by high Δt's. The measured average coefficients were approximately equal for the three types of channels in the bundle and within 10% of values predicted by the usual empirical equations. (auth)

7660 (NEI-156) DISCHARGE OF HIGH ENTHALPY WATER FROM A LONG CYLINDRICAL CONTAINER. R. I. Hodge (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1961. Reprinted Nov. 1961. 39p. (AECL-1388)

Measurements were made of the rate of emptying of a long tube, initially filled with high-enthalpy liquid water and suddenly opened at one end. The tube was 0.63 in. inside diameter, 259 diameters long, and the condition of the water content was varied, up to a maximum enthalpy of 520 Btu/lb. The measured discharge rate was compared with that calculated, using the method of characteristics, at one enthalpy. It appeared that non-uniformity in the condition of the water along the length of the tube, which was not considered in the calculation technique, led to serious error in the calculated values during the early stage of the discharge. (auth)

7661 (TID-14393) GROWTH OF A VAPOR-FILLED CAVITY NEAR A HEATING SURFACE AND SOME RELATED QUESTIONS. Report No. 60-76. Progress Report No. 8. Kurt Forster (California. Univ., Los Angeles. Dept. of Engineering). Aug. 1960. Contract AT(11-1)-34. 25p.

The growth of a vapor bubble on a heating element immersed in a liquid which is at saturation temperature or subcooled far from the heating surface but which is superheated near the heating surface, was treated as a problem of heat conduction with evaporation on a boundary. Initially, a one parameter negative exponential dependence of liquid temperature on distance from the heating surface was assumed and the distortion introduced by the growth of the cavity was neglected. The results showed, in agreement with experiment, that in a liquid at saturation temperature the radius grows as $t^{1/2}$ at first (t is time) and as $t^{1/3}$ for $t \to \infty$; for a subcooled liquid the radius as a function of time is given as an infinite series in terms of a quantity H, later identified with the thickness of the thermal boundary layer. For the simpler case of uniform initial temperature of the liquid, the method is shown to give results identical to those known for several years for low pressure while yielding a small correction for large pressure. Several relations between boundary layer thickness in a boiling liquid, maximum radius attained by the cavity before collapse, and superheat and subcooling were derived and compared with experiment. For large subcooling the boundary layer thickness is shown to be about one-half (or less) the size of the maximum radius. Physical considerations concerning the mechanism of heat transmission to a boiling liquid led to the definition of a heat diffusivity, the exchange diffusivity $a^* = M^2 a$, with M the dimensionless ratio of enthalpies of superheated liquid and of saturated vapor. The dimension of the thermal boundary layer is shown to be the diffusion length for the exchange diffusivity. (auth)

7662 (TID-14556) LOW HEAT-FLUX BOILING. First Quarterly Progress Report for the Period July 1, 1961 to October 1, 1961. John A. Clark, Herman Merte, Jr., Edward R. Lady, Jaring Vander Veen, and Wen-Jei Yang (Michigan. Univ., Ann Arbor. Coll. of Engineering). Contract AT(38-1)-260. 68p. (ORA-04653-1P)

An experimental system is described for studying the boiling of water from the outer surface of tubes at low values of heat flux (from 5,000 to 100,000 Btu/hr-ft^2) and pressures up to 2000 psia for both natural and forced convection. The design of the major components is virtually complete and work on accessory items is proceeding. The instrumentation requirements are being detailed. The results of a literature survey are presented. (auth)

7663 (UCRL-6676) SHOCK LOCATION DURING TWO-PHASE FLOW IN AN OVEREXPANDED NOZZLE (thesis). Ross Allan Fiedler (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1, 1961. Contract W-7405-eng-48. 68p.

Submitted to Univ. of California, Berkeley.

An investigation was made of the location of compression zones occurring during the overexpansion of low quality steam-water flow through a converging-diverging nozzle. The compression zone locations were found to be dependent upon the rate of mixture expansion, which was determined by the chamber pressure and mixture quality. For a fixed quality, the compression zone moved downstream with increasing chamber pressure. For a fixed chamber pressure, the compression zone moved downstream with decreasing quality. The phase change during the expansion was calculated from an isentropic homogeneous equilibrium flow model, and the area occupied by the vapor phase was calculated from a two-phase momentum exchange model. It was concluded that the compression zones were formed by a pressure shock initiated by the overexpanded vapor phase being smeared out by the accompanying liquid drops that were not immediately affected by the vapor shock. (auth)

7664 (AEC-tr-4905) FLOW OF WATER THROUGH CONCENTRIC AND ECCENTRIC CYLINDRICAL PACKING GLANDS WITH AND WITHOUT ANNULAR GROOVES. Erich Schneckenberg. Translated for Oak Ridge National Lab., Tenn. from Z. angew. Math. u. Mech., 11: 27-40 (Feb. 1931). 52p.

A flow apparatus was constructed with an annular slot for concentric and eccentric adjustments between 0 and 1 mm, on a concentric basis, and which indicates a magnification of 200. Experiments in which the specific gravity was eliminated in vertical slots show that the influence of the height of fall could be disregarded and would appear only in a larger clearance and very low pressures. For laminar flow the loss of water increases with the 3rd power of the clearance, and for a turbulent flow it increases with the 1.5 power. Each eccentricity increases the amount of flow and with full eccentricity in the case of laminar flow, without grooves, the amount of flow is 2.45

times that for concentricity and only 2.1 times of the latter in the case of grooves where turbidity occurs. In the case of turbulent flow, with grooves where R = 2000 to 13,000, the amount of flow is 1.15 times; with grooves where R = 1000 to 10,000 it is 1.26 times; and without grooves where R = 20,000 and over 100,000 probably 1.26, too. These values agree quite well with formulas derived theoretically from which values of 2.5 and 1.21 were calculated, respectively. (B.O.G.)

7665 (AEC-tr-4967) PLANE AND SPATIAL FLOW OF VISCOUS, INCOMPRESSIBLE, INERTIA-FREE FLUIDS BETWEEN ECCENTRIC, MUTUALLY ROTATING CYLINDER SURFACES. H. Reissner. Translated for Oak Ridge National Lab., Tenn. from Z. angew. Math. u. Mech., 16: 275-87(1936). 30p. (Includes original, 13p.).

A discussion is given of the developments in deriving a solution to the spatial problem for annular flow. Considerations are presented for satisfying the boundary conditions for very wide and very narrow bearings. Observations are described of the flow lines which represent wave curves, with a period of 2π, for sufficiently narrow bearings and very small eccentricities. (B.O.G.)

7666 APPARATUS FOR STUDYING HEAT TRANSFER IN A FLUIDIZED-BED REACTOR. N. I. Syromyatnikov, L. K. Vasanova, and Yu. N. Shimanskii. Atomnaya Energ., 11: 544-6(Dec. 1961). (In Russian)

Reactors in which the fuel is suspended in the stream of the heat transfer agent circulating in a closed loop present many advantages in comparison with heterogeneous systems. The flow of heat from the particles acting as a heat source to the medium must be studied experimentally. The ratio of the diameters of the reactor and of the particles D_r/d is an important diameter in this respect. The problem of heat generation in the particles and of the heat transfer was studied in a system which simulated the fluidized-bed reactor conditions by vortex currents in a high-frequency magnetic field. The heat released by the vortex currents is controlled by the frequency and the tension of the magnetic field, the dimensions of the particles and the electromagnetic properties of the material used. The apparatus consisted of a cylinder with double glass walls and induction generators. Al, Cu and graphite particles with diameters ranging from 0.2 to 2 mm were used. Instrumentation was provided for measuring the temperature of the particles and of the medium. The apparatus is well suited for studying the heat transfer between gases and liquids and dispersed particles suspended in the medium. (TTT)

7667 THE EFFECT OF A MAGNETIC FIELD ON FREE CONVECTION HEAT TRANSFER. E. M. Sparrow (Univ. of Minnesota, Minneapolis) and R. D. Cess. Intern. J. Heat and Mass Transfer, 3: 267-74(Dec. 1961). (In English)

Free convection heat transfer due to the simultaneous action of buoyancy and induced magnetic forces is investigated. The analysis is carried out for laminar boundary-layer flow about an isothermal vertical plate. It is found that the free convection heat transfer to liquid metals may be significantly affected by the presence of a magnetic field; but that very small effects are experienced by other fluids. (auth)

7668 ON CONJUGATED PROBLEMS OF HEAT TRANSFER. T. L. Perelman (Inst. of Energetics, Academy of Sciences, Minsk). Intern. J. Heat and Mass Transfer, 3: 293-303(Dec. 1961). (In English)

The simplest conjugated boundary value problems of heat transfer, in which heat conduction equations are solved in common for a body with heat sources and for a liquid flowing round the body, are studied. The method of the asymptotic solution of integral equations occurring in conjugated problems is presented. (auth)

7669 HEAT TRANSFER OF A PLATE IN A LIQUID FLOW. A. A. Zhukauskas and A. B. Ambrazyavichyus (Inst. of Energetics and Electrical Engineering, Academy of Sciences of the Lithuanian S.S.R.). Intern. J. Heat and Mass Transfer, 3: 305-9(Dec. 1961). (In English)

Results are presented from experimental investigations of heat transfer from a plate in a flow of air, water, and transformer oil at different directions of heat flow over the range of Re_f numbers from 2×10^1 to 3×10^7 and that of Pr_f – from 0.701 to 380. Formulas were obtained to calculate heat transfer by a plate in a liquid flow. (auth)

7670 A VARIATIONAL PROBLEM RELATING TO COOLING FINS WITH HEAT GENERATION. Chen-ya Liu (Carnegie Inst. of Tech., Pittsburgh). Quart. Appl. Math., 19: 245-51(Oct. 1961).

Optimum fin geometry for maximum heat dissipation per unit weight is derived. The calculus of variations is used. The heat generation function is assumed to be a function of the coordinate along the fin. Euler equations are obtained, and sufficient conditions are derived. The solution is also provided for the case in which the heat generation function is linearly dependent on temperature only. The temperature is found to be a hyperbolic sine function. Explicit expressions for the fin shape and for the maximum heat dissipation are derived for rectangular and circular fins. (L.N.N.)

7671 IMPROVEMENTS IN OR RELATING TO VALVED DUCTING. George Blackburn and Everett Long (to United Kingdom Atomic Energy Authority). British Patent 886,320. Jan. 3, 1962.

A coaxial ducting assembly is designed with control valves for fluid flow to and from a heat exchanger. The ducting comprises an inner pipe for the hot fluid flow and an outer pipe forming an annulus between the pipes for the cool fluid flow. The inner pipe has an internal layer of heat insulating material and a butterfly valve, and an apertured annular member with associated poppet valves is provided laterally partitioning the annulus. Strengthening members are provided between the pipes in the region of the valves to prevent disturbance of the valve seating. The advantages of this ducting are that expansion bellows are not required and the outer pipe provides a safety factor should the inner pipe fracture in use. (D.L.C.)

7672 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Andre Huet. British Patent 887,299. Jan. 17, 1962.

A reactor is described in which the fuel rods are encased in jackets having heat-exchange and coolant-deflecting surfaces arranged so that the rate of heat exchange for one fuel rod is related to its position in the reactor. The rate of coolant flow and the spacing of fuel rods in different regions of the reactor may also be varied. (D.L.C.)

Instrumentation

Refer also to abstracts 7370, 8027, 8028, 8029, 8030, 8031, 8066, 8071, and 8072

7673 (AEET/TP/2) PRODUCTION OF PLASTIC SCINTILLATORS. R. Y. Deshpande and G. K. Bhide

(India. Atomic Energy Establishment, Trombay). 1961. 18p.

The production of 2 ft × 2 ft × 4 in. plastic scintillator slabs is described. The scintillator uses polystyrene as base, p-terphenyl as fluor and popop as wavelength shifter. It is prepared by polymerizing the monomer solution near its boiling point. Some factors governing the successful preparation of the scintillator are discussed. (auth)

7674 (AFOSR-1525) SOME USEFUL INFORMATION FOR THE DESIGN OF AIR-CORE SOLENOIDS. PART I. RELATIONSHIPS BETWEEN MAGNETIC FIELD; POWER, AMPERE-TURNS AND CURRENT DENSITY. PART II. HOMOGENOUS MAGNETIC FIELDS. D. Bruce Montgomery and J. Terrell (Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.). Nov. 1961. Contract AF19(604)-7344. 51p.

Relations relating power, magnetic field, current density, and ampere-turns in terms of certain dimensionless factors are summarized for many types of coil geometries and current distributions. A number of plots of these factors are presented. The field homogeneity in magnet structures is presented in terms of a series expansion about the origin utilizing Legendre Polynomials. A number of tables to facilitate design of homogeneous fields are presented. A method of achieving homogeneity in long solenoid structures by the use of determinants is discussed. Expressions for the axial field from uniform and radially varying current density coils are given. (auth)

7675 (ASD-TR-61-32) FURTHER DEVELOPMENT OF MICROWAVE GAMMA-RAY ION CHAMBER. J. W. Aichroth, R. L. Sleven, and K. C. Speh (Airborne Instruments Lab. Div. of Cutler-Hammer, Inc., Deer Park, N. Y.). July 1961. 44p.

A microwave gamma-ray ion chamber has been developed that measures gamma radiation from 10^8 to 10^{10} ergs per gram-hour (carbon in the presence of a neutron flux of 10^{10} neutrons per square cm per second. The choice of materials, development of a unique vacuum system, and fabrication of chambers suitable for operation to 500°C in a high neutron flux are discussed. Data are presented on the response of an ion chamber to various ratios of incident gamma, thermal neutron, and fast neutron fluxes. (auth)

7676 (CNEN-103) RECENT COMPTON SPECTROMETERS FOR MEASUREMENTS OF NEUTRON CAPTURE GAMMA-RAYS. M. Mladjenovic (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Oct. 1961. 23p.

Included is a part of the material presented for discussion, preceding the construction of a Compton spectrometer at Centro di Studi Nucleari della Casaccia. A brief discussion is given of most recent Compton spectrometers, published after a recent review was completed. (auth)

7677 (DC-58-9-722) INDUCED NOISE IN INSTRUMENT SIGNAL CABLES. Robert L. Dudley (General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho). Sept. 19, 1958. Contract AT(11-1)-171. 50p.

Theoretical and empirical equations were developed to determine the amount of electrostatic or magnetic pickup which may be expected in an instrument cable system. Experiments were performed to determine the effectiveness of certain shielding configurations for static and magnetic pickup. Methods of predicting the amount of pickup which may be anticipated under various configurations are discussed. Tests were also conducted to show the amount of pickup caused by ground loop conditions. (auth)

7678 (DC-59-5-234) LOGARITHMIC PULSE RATE GENERATOR. Final Report. J. R. Whitten (General Electric Co. General Engineering Lab., Schenectady, N. Y.). May 20, 1959. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Contract AT(11-1)-171. 30p.

A signal generator was designed and built for simulating the output of a fission chamber which is measuring the buildup of power in a nuclear reactor. (D.L.C.)

7679 (DC-60-7-733) USE OF ZINC SULPHIDE CRYSTAL AS LOW LEVEL NEUTRON SENSORS. Jay M. Strong (General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho). July 11, 1960. Contract AT (11-1)-171. 24p.

A conventional photomultiplier tube optically coupled to a boron-loaded plastic crystal is used as a neutron detector giving a good neutron to gamma ratio. Test results are indicated which show the relative sensitivities to both neutrons and gammas for various photomultiplier tubes and sizes of crystals. Results of tests on a small compact sensor designed with a small tube, crystal, and self-contained preamplifier are given. (auth)

7680 (DC-60-8-121) EVALUATION OF A 700°C FISSION CHAMBER DESIGN. R. L. Treinen and J. E. Schroeder (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 22, 1960. Contract AT(11-1)-171. 25p.

The evaluation testing of a fission chamber design with respect to operation to temperatures of 700°C is described. The responsivity of the chamber design is approximately 0.01 counts • sec^{-1} per unit ambient thermal neutron flux. The filling gas was 99% argon–1% nitrogen to a pressure of one atmosphere and the observed signal pulse rise time was 2×10^{-7} sec. The chamber consists of nickel, stainless steel, a ceramic-to-metal vacuum seal and a noise-free lead assembly. After 1020 hours of operation at 704°C (1300°F) the counting rate for one chamber while at 704°C was observed to be approximately 10% less than for room temperature operation. (auth)

7681 (DC-60-9-46) NUCLEAR INSTRUMENTATION AUTOMATIC PULSE DATA SYSTEM. E. A. Korengel (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 30, 1960. Contract AT(11-1)-171. 27p.

The operating instructions and maintenance for the Nuclear Instrumentation Automatic Pulse Data System are presented. This is a rack of instruments specifically selected to provide a facility for automatically obtaining characteristic data from pulse type nuclear instruments. (auth)

7682 (DC-60-10-75) FISSION COUNTER NEUTRON PULSE AND CIRCUIT ELEMENT CHARACTERISTICS. C. N. Jackson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 12, 1960. Contract AT(11-1)-171. 48p.

The signal characteristics and electrical parameters of a typical fission counter were investigated at 0, 130, and 40,000 nv neutron flux. The investigation and analysis covered many properties such as randomness, self-alpha, pulse shape, pulse height, pulse pile-up, pulse simulation, and neutron effect on counter capacity. Both photographic and statistical techniques were employed in making the measurements. Equivalent circuit techniques were used in the analysis of the counter operation. Recommendations are made for the counter input circuit design. (auth)

7683 (DC-60-11-73) DESCRIPTION AND ANALYSIS OF A SENSITIVE BF_3 FILLED UNCOMPENSATED IONIZA-

TION CHAMBER. N. M. Gralenski and J. E. Schroeder (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 10, 1960. Contract AT(11-1)-171. 13p.

Information and data pertaining to twenty-two chambers recently received by the Critical Experiments Unit are presented. The thermal neutron response of the chambers was obtained experimentally and analytically. Test results of amperes obtained at various voltages were compared to calculated results. At the operating voltage of the chambers, the calculations gave results higher (as expected) by about 5%. Techniques in generation of enriched BF_3 gas are also given. (auth)

7684 (GAMD-1221) SURVEY OF FISSION PRODUCT DETECTORS FOR NUCLEAR REACTORS. Heinz W. Georgi (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 27, 1960. Contract AT(04-3)-314. 10p.

A literature survey was made of methods used for the detection of ruptured fuel elements in various reactors. The detection methods used include differential gamma ray detectors, ion exchange monitors, delayed neutron monitoring, monitoring of precipitation of solid daughters of krypton and xenon, and Cherenkov counters. The discussion of methods used to locate the burst fuel elements contains a brief description of each of the monitoring systems used in the Calder Hall Reactors, G-1 and -3, EDF-1, NRU, S3G, and Dresden Power Reactor. 13 references. (B.O.G.)

7685 (GEMP-70) HIGH TEMPERATURE MATERIALS PROGRESS REPORT NO. 70, OCTOBER 1, 1961 – NOVEMBER 30, 1961. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Jan. 1962. Contract AT(40-1)-2847. 26p.

The feasibility of driving a string of balls for reactor control by means of an electromagnetic pump was investigated. Attempts to move steel balls met with little success. Emphasis was placed on reducing the complexity of the circuitry of switching circuits for reactor safety systems. Methods of fabricating capacitance elements are being explored and an electrode-dielectric sheet, produced by deposition and subsequent oxidation of aluminum on platinum or tungsten, promises favorable temperature and electrical characteristics. Two fission counters were developed which were operated successfully to 1500°F for times in excess of 130 hours each. Two design concepts for nuclear sensors are being pursued: an a-c ionization chamber and a charged-fragment detector. (M.C.G.)

7686 (NAA-SR-5732) DETECTION DEVICE FOR HYDROGEN IN SODIUM. K. A. Davis (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 15, 1962. Contract AT(11-1)-Gen-8. 17p.

A laboratory device capable of detecting trace amounts of hydrogen in liquid sodium has been developed. In loop operation the device extracts hydrogen from flowing sodium by allowing hydrogen diffusion through a nickel membrane. Rate-of-rise measurements on a vacuum system placed on the exterior of the nickel barrier yields quantitative results. Spectrographic analysis of collected gas verifies the gas to be hydrogen. Sensitivity to detect 1.4 ppm (by weight) of hydrogen in sodium has been demonstrated. (auth)

7687 (SCTM-22-61-81A) A METHOD OF MEASURING RMS VOLTAGE AND CURRENT. L. B. Converse (Sandia Corp., Albuquerque, N. Mex.). Jan. 1962. Contract [AT(29-1)-789]. 13p.

A method is described which simplifies the technique and equipment required for measuring rms voltage and current. (auth)

7688 (SCTM-230-61(81)) AIRBORNE SPECTRUM ANALYZERS. B. W. Jordan, Jr. (Sandia Corp., Albuquerque, N. Mex.). Jan. 1962. Contract AT(29-1)-789. 13p.

Some problems associated with telemetering and analysis of random vibrations are reviewed, and a system for obtaining an airborne analysis of vibration data from missiles is proposed. (auth)

7689 (SCTM-243-61(14)) A PULSE-TIMING TESTER. Leonard Ehrman (Sandia Corp., Albuquerque, N. Mex.). Sept. 1961. Contract [AT(29-1)-789]. 16p.

A single-chassis transistorized tester is described which will measure the time of occurrence of a negative pulse after a given fiducial point, as well as the width of the pulse after this point to 0.1 microsecond. (auth)

7690 (TID-14767) THE EFFECT OF PHOTON-IRRADIATION INDUCED CHANGES IN PHOTOELECTRIC EFFICIENCY ON THE OPERATION OF PHOTOMULTIPLIERS. F. T. Gould, R. C. Rohr, and D. J. Anthony (Knolls Atomic Power Lab., Schenectady, N. Y.). [Nov. 8, 1961]. Contract [W-31-109-eng-52]. 10p.

Presented at American Physical Society, New York City, January 24-27, 1962.

The analysis of the operation of the photomultipliers was made by observing the pulse output at extreme conditions and working back to normal conditions. The physical mechanism which is said to account for increased efficiency of photoelectric emission brought about by photon irradiation of the photo-cathode, explains several inconsistencies in the operation of the photomultiplier. It is felt that the pulse output method provides an experimental approach for basic studies of the semiconductor type of photo-cathode. (B.O.G.)

7691 (WAPD-AD-TH-545) HIGH ACCURACY THERMOCOUPLE MEASUREMENT TECHNIQUES. E. W. Fink and T. W. Hunt (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 28, 1959. Contract AT(11-1)-Gen-14. 88p.

Methods were studied to improve the accuracy of out-of-pile and in-pile thermocouple temperature measurements and to find promising thermocouple materials which could be used as alternates to Chromel-Alumel. Practical measurement techniques available to achieve ±1°F accuracy are described. The in-pile stability of presently used thermocouples has not been clearly established. Promising alternate thermocouple materials include iron-constantan, and Chromel P-constantan for in-pile applications and platinum–platinum–10% rhodium and Platinel for out-of-pile use. Recommendations are given for conducting additional in-pile tests to establish the error caused by calibration drift, and to establish the stability of iron-constantan and Chromel P-constantan. (B.O.G.)

7692 (WAPD-R(TH)-575) AN INFRARED RADIATION METHOD FOR CALIBRATING TRANSIENT THERMOCOUPLES. E. W. Fink (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 19, 1960. Contract AT(11-1)-Gen-14. 39p.

Tests are described which evaluated two possible applications of infrared (radiometer) techniques as a method of measuring the transient response of thermocouples welded to the outside wall of electrically heated test sections, and as a direct method of measuring the temperature of the outside wall of these test sections for use as a DNB detector. The response characteristics of various types of thermocouples were compared. The results indicated radi-

ometer accuracy of about ±5°F with a time constant of about 45 milliseconds. Improved attachment techniques and the use of swaged thermocouples resulted in significant decrease in the time constants of the thermocouples. (auth)

7693 (CEA-tr-R-1422) OSCILLATEUR A BLOCAGE A TEMPS DE MONTEE DE L'ORDRE DE LA NANOSECONDE. (Blocking Oscillators with Time Intervals of the Order of Nanoseconds). Yu. (Iu.) P. Mel'nikov and S. Ya. (Ia.) Shats (Shatz). Translated into French from Radiotekhnika, 15: No. 6, 36-44(1960). 27p.

The processes taking place in a nanosecond-range blocking oscillator are analyzed. Account is taken of the fact that, for time scales in this range, the response is determined by both the operating parameters and inert parameters of the circuit. The domain of circuit parameters is studied for which pulses having a minimum time and an optimal amplitude may be obtained. (T.F.H.)

7694 USE OF RESONANCE ABSORBERS FOR MEASURING NEUTRON SPECTRA IN FAST REACTORS. V. I. Golubev, V. I. Ivanov, M. N. Nikolaev, and G. N. Smirenkin. Atomnaya Energ., 11: 522-7(Dec. 1961). (In Russian)

Use of thin foils with strong resonance activation cross section makes it possible to determine neutron fluxes having energies corresponding to the resonance maxima. While this method may be used for determining the relatively soft spectra in the reflectors of fast reactors, the strongest resonance may become comparable to others lying at much lower or higher energy levels and therefore the activity induced by neutrons corresponding to the resonance energy must be determined by special methods. This "resonance blocking" method was used for determining the resonance flux distribution of 4.9-ev and 2.95-kev neutrons, using Au^{197} and Na^{23}, in the reflectors of the BR-1 and BR-5 reactors. The method, designated as "deduction of the $1/\nu$ contribution" was carried out by means of absorbers containing 100 mg/cm^2 of Na_2CO_3 using a small boron chamber as the $1/\nu$ detector. The contribution of the resonance neutrons ranged from 20 to 50%, depending on the position of the absorbers in the reactor. The gold foils used contained 3.05 and 6.10 mg/cm^2 of Au^{197}. (TTT)

7695 A PHOTOEMULSION FOR NUCLEAR INVESTIGATIONS (PR-2). N. A. Perfilov, N. R. Novikova, V. I. Zakharov, and Yu. I. Vikhrev. Atomnaya Energ., 11: 543-4(Dec. 1961). (In Russian)

For the first time, the high density of 60 grains/100μ was obtained in the tracks of relativistic particles with a newly developed emulsion. This material was first sensitized with gold, then hypersensitized with triethanolamine; unfortunately the hypersensitized films had a short shelf life. The second step was therefore eliminated and a new process developed, so that by using an excess of $AgNO_3$ during the preparation of the emulsion, coalescence of the microcrystals would lead to an increase in the density of the tracks. It was found that an increase of the most probable dimensions of the AgBr crystals from 0.08 to 0.12μ results in an increase in the density of the tracks of relativistic particles to about 40 to 45 grains/100μ. (TTT)

7696 USE OF SEMICONDUCTOR SENSING ELEMENTS FOR RECORDING THE RELATIVE DISTRIBUTION OF THE FAST NEUTRON FLUX IN THE VVR-M REACTOR. R. F. Konopleva and S. R. Novikov. Atomnaya Energ., 11: 546-7(Dec. 1961). (In Russian)

Usually S, P and Al foils with energy thresholds ranging from 1.5 to 6 Mev are used as threshold detectors for determining the fast neutron distribution in beam holes. Such measurements may also be carried out by measuring the change in the electrical conductivity of semiconductors exposed to fast neutrons; this is based on the fact that the concentration of lattice defects which determine the conductivity is proportional to the integrated fast neutron flux. As sensing elements n-type Ge specimens in a 0.5-mm thick Cd cladding were used. The conductivity was followed by determining the changes in the current applied under constant voltage to the specimens during the irradiation. The relative distribution of the fast neutron flux in one of the vertical beam holes in the reflector of the reactor located in the A. F. Ioffe Physical-Technical Institute was determined by this method. (TTT)

7697 MECHANISM, USE, AND PROPERTIES OF GEIGER-MUELLER COUNTERS. P. I. Giacomo Redaelli (Centro Informazioni Studi Esperienze, Milan). Automazione e automatismi, 5: No. 1, 26-34(Jan.-Feb. 1961). (In Italian)

A survey is presented on the nature, construction, use, and prototypes of Geiger-Mueller counters. Included in this survey is a generalized circuit diagram, voltage characteristics, sensitivity of the circuit system, efficiency of cathode plate and pole, tube design for various radiation measurements, effective range of the counter, and performance of various materials used in the construction of the cathode. The techniques used in the construction of the meter are briefly described. (N.W.R.)

7698 THE SHAPE OF THE SENSITIVE VOLUME OF SPARK COUNTERS OF THE WIRE-PLATE TYPE. Daniel Blanc and Paul Laborie (Faculté des Sciences, Toulouse, France). Compt. rend., 253: 1786-8(Oct. 23, 1961). (In French)

The sensitivity of a wire counter irradiated frontally (α particles) is at a maximum in the symmetry plane containing the wire. Under lateral irradiation, the maximum is close to the plate. It is the same for several parallel wires if their separation δ, is very wide with respect to their distance, d, from the plate. If $\delta \leq d$, the maximum under lateral irradiation is closer to the wire the smaller is δ. (tr-auth)

7699 THE RELATIONSHIP BETWEEN FLUORESCENCE INTENSITY AND COUNTING EFFICIENCY WITH LIQUID SCINTILLATORS. H. R. Lukens, Jr. (Shell Development Co., Emeryville, Calif.). Intern. J. Appl. Radiation and Isotopes, 12: 134-40(Dec. 1961). (In English)

The relationship between light output and counting efficiency of liquid scintillation samples is examined and found to be in accord with Poisson statistics. The characterization of a single-channel liquid scintillation counter necessary to permit its use as a photometer is described, and the value of such a use is illustrated in several aspects of liquid scintillation counting. (auth)

7700 A TECHNIQUE FOR THE RESOLUTION OF COMPLEX GAMMA SPECTRA USING A SINGLE-CHANNEL GAMMA-RAY SPECTROMETER. T. S. Elleman, J. E. Howes, Jr., and D. N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). Intern. J. Appl. Radiation and Isotopes, 12: 142-4(Dec. 1961). (In English)

The technique described is simple, applicable to a single-channel gamma spectrometer, relatively insensitive to spectrometer drift, and suitable for the resolution of a wide variety of gamma emitting isotopes. The technique is described in terms of the resolution of the complex spectrum for the Cs^{134}–Cs^{137} mixture. By obtaining counting rates for an unknown Cs^{134}–Cs^{137} mixture at two spectrom-

eter base settings and then obtaining the counting rates of pure samples of Cs^{134}–Cs^{137} at the same settings, it is possible to calculate the relative counting contributions of both isotopes in the unknown mixture. The results obtained in the resolution of a number of mixtures are tabulated. (P.C.H.)

7701 ON THE DETERMINATION OF DISINTEGRATION RATES BY THE COINCIDENCE METHOD USING HIGH EFFICIENCY DETECTORS. R. W. Hayward (National Bureau of Standards, Washington, D. C.). Intern. J. Appl. Radiation and Isotopes, 12: 148-50(Dec. 1961). (In English)

Discussion is given on the coincidence method when applied under high efficiency conditions. Discussion is also given on disintegration rates in which a separation of the total observed coincidence rate into trues and accidentals is made. The definition of coincidence is given, and the disintegration rates are determined in terms of the total coincidence rate and single-channel counting rates. (P.C.H.)

7702 SPACE AND TIME RESPONSE OF AIRBORNE RADIATION SENSORS FOR THE MEASUREMENT OF GROUND VARIABLES. John A. Dutton (Univ. of Wisconsin, Madison). J. Geophys. Research, 67: 195-205(Jan. 1962).

Mathematical relationships between true values of ground variables and values recorded by radiation-sensitive instruments mounted on an airplane in horizontal flight are given. Temporal and spatial distortions are considered; atmospheric depletion is not. Instruments are described. It is shown that measurement of space averages is possible, and weighting functions affecting recorded values are exhibited for both narrow- and wide-beam instruments. A tractable analysis of the characteristics of wide-beam instruments requires assumptions about the homogeneity or antisymmetry of the ground variable. Measurement of variations in small areas is shown to be difficult with standard instruments. Weighting functions are derived which allow reconstruction of the variance and cross spectra of ground values from the spectra of the recorded values. The development suggests important factors in flight planning and yields methods of error analysis. (auth)

7703 A FOCUSING COLLIMATOR FOR RESEARCH IN SCANNING. J. E. Francis, Jr., C. C. Harris, and P. R. Bell (Oak Ridge National Lab., Tenn.). J. Nuclear Med., 3: 10-17(Jan. 1962).

A description is given of the latest directional gamma detector developed at Oak Ridge National Laboratory. Gamma rays are detected by a 3-inch diameter by 2-inch thick NaI(Tl) crystal integrally mounted on a 3-inch phototube. The crystal is housed in a massive tungsten alloy shield, two inches thick at the sides and 3 inches thick at the front. The focusing element is a conical gold insert with 37 tapered hexagonal holes focused on a point 3 inches from its front face. Because of the use of tungsten and gold, the assembly is more expensive than lead collimating shields. However, it is believed that the increased expense may be justified by the unremarkably improved performance. In particular, the improved shielding of the new detector appears to have alleviated some of the problems in outlining the liver. (P.C.H.)

7704 THE ORINS LINEAR SCANNER IN CLINICAL DIAGNOSIS. Felix J. Pircher, Marshall Brucer, A. C. Morris, Jr., and Ruth Black (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). J. Nuclear Med., 3: 26-40(Jan. 1962).

Important changes in the ORINS linear scanner, in comparison to earlier instruments, are increased sensitivity, adjustable and more efficient collimation, the use of two detector units opposite each other, recording count rate over the ventral and dorsal aspects of the patient simultaneously, and reduced effect of the absorber. Results are given of an investigation to determine the usefulness of linear scanning in general, and of the ORINS linear scanner in particular, in clinical diagnosis using various radioisotopes. The scans of 10 patients who were studied with As^{74}, Cu^{64}, I^{131}, Au^{198}, Y^{90}, and Na^{24} are presented. It was concluded that the ORINS linear scanner is a useful addition to nuclear instrumentation in clinical investigation. It profiles the radioactivity within the patient, it scans the whole body in ten minutes, and offers some hope of obtaining quantitative data. (P.C.H.)

7705 REALIZATION AND TESTS OF A COMPRESSED GAS ČERENKOV COUNTER. STUDY OF THE POLLUTION OF A BEAM. J. Duboc (College de France, Paris), J. Banaigs, and J. F. Detoeuf. J. phys. radium, 22: Suppl. to No. 2, 64A-7A(Feb. 1961). (CEA-2000). (In French)

A compressed-gas Cherenkov counter is described which is used for studying mixed beams of electrons, mesons (μ), and mesons (π). Graphical plots are presented which indicate the location of each beam over momentums varying from 220 to 1100 Mev/c. (N.W.R.)

7706 A NEW METHOD OF MEASUREMENT OF ABSORPTION DOSE RATE FROM TERRESTRIAL BACKGROUND RADIATION. Hironobu Watanabe (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiation Research (Japan), 2: No. 2, 7p.(1961). (A/AC.82/G/L.687) (In English)

A new method for calculation of absorption dose rate is described. The method involves a spectrometric method, using plastic scintillator, for the measurement of radioactivity in soil samples and a method of absorption dose calculation and the absorption dose rate values of specific soil samples in various districts of Japan. The exposure dose rate values calculated from gamma-ray spectra taken by the NaI(Tl) crystal detector are summarized. (auth)

7707 MEASUREMENT OF PROFILES OF TRACKS IN NUCLEAR EMULSIONS. Wen-ti Chang and Lieng Yu. K'o Hsüeh Tŭng Pao, No. 22, 760-1(1959).

The average thicknesses of proton, alpha, and lithium nucleus tracks were measured at the end of their ranges at distances 5 to 400 microns from the stopping point. Good distinguishability of tracks of these particles is demonstrated. (Referat. Zhur. Fiz., 9: 22394).

7708 SEMICONDUCTOR α PARTICLES DETECTORS. J. Chwaszezewska, S. Chwaszczewski, and K. Dybowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 635-41(1961). (In Russian)

The characteristics of gold-silicon surface barriers for use as alpha particle detectors are described. The dependence of resolution and pulse light on operating voltage and resistance is established. (N.W.R.)

7709 MULTIPLE-WIRE SPARK COUNTERS FOR COUNTING α-PARTICLES AND NEUTRONS. S. Kawata and T. Aragaki (Konon Univ., Kobe, Japan). Nuovo cimento (10), 22: 875-8(Nov. 16, 1961). (In English)

A counter with a spacing of 2.5 mm, consisting of 15 wires, and one with a spacing of 2 mm, consisting of 5 wires, were constructed and studied. Tungsten wires 0.1 mm thick and 40 mm long were stretched on a frame of acrylresin 60 × 70 × 20 mm at a distance of 1.1 mm above a plate of stainless steel separated by two spacers of glass. A Po^{210} source was placed 28 mm above the plane of wires, and irradiation was made in an end-on direction through a

circular hole 0.8 mm in diameter and 5.3 mm in length placed immediately below the source. Count variations were measured and results are represented graphically. Methods of increasing the efficiency are discussed. (L.N.N.)

7710 THE BASIC DESIGN OF A GUARDED-FIELD THIMBLE IONIZATION CHAMBER—FURTHER ANALYTICAL INVESTIGATIONS. Barry Barber (London Hospital Research Labs.). Phys. in Med. Biol., 6: 389-400(Jan. 1962).

The mathematical investigation of the electrostatic field in a guarded-field chamber is extended to include the effect of a finite annular wall gap; other approximations made in deriving the potential function are discussed. Rapidly convergent series, which facilitate the handling of the infinite series, as well as methods of investigating the behavior of the field lines are given. The evaluation of the collecting volume is discussed in detail, and the design curves are given complete with the data for the limiting case when the collecting electrode radius approaches the total internal radius of the chamber. Annular collecting electrodes are also considered and an expression for the corresponding collecting volume is given. Finally, a discussion of guarded fields in various other cavity shapes is included and the possibility of a spherical guarded-field chamber is noted. (auth)

7711 EFFECT OF VARIATIONS IN THE QUANTUM COUNTING EFFICIENCY OF DETECTORS ON THE MEAN WAVELENGTH OF X-RAY EMISSION LINES. A. J. C. Wilson and B. W. Delf (University Coll., Cardiff, Wales). Proc. Phys. Soc. (London), 78: 1256-8(Dec. 1, 1961).

The general case of a true wavelength distribution $I(\lambda)d\lambda$ modified by a factor $f(\lambda)$ is considered. Expressions for the true and the modified centroids are derived. The fractional change in the centroid wavelength is $\Delta\lambda/\lambda = Vf'/\lambda f$, where V is the wavelength variance. The fractional rate of change of quantum counting efficiency with wavelength, f'/f, is measured for Geiger, proportional (Xe), proportional (Kr), film, and scintillation detectors for wavelengths of Mo, Cu, and Cr Kα radiations. Results are represented in graphic and tabular forms. (L.N.N.)

7712 LITHIUM ION SOURCES. Samuel K. Allison and M. Kamegai (Univ. of Chicago). Rev. Sci. Instr., 32: 1090-2(Oct. 1961).

The preparation of artificial β-eucryptite ($Li_2O\ Al_2O_3\ 2SiO_2$) as a filament coating for the emission of Li^+ ions is discussed. Two ion sources with their initial focusing gaps are described. (auth)

7713 TRANSMISSION CURRENT MONITOR FOR HIGH ENERGY ELECTRON BEAMS. S. I. Taimuty and B. S. Deaver, Jr. (Stanford Research Inst., Menlo Park, Calif.). Rev. Sci. Instr., 32: 1098-1100(Oct. 1961).

A current monitor suitable for use with continuous or pulsed high energy electron beams is described. It functions by collecting slow secondary electrons emitted on passage of high energy electrons through a thin foil in vacuum. The secondary current is a linear function of primary current at average primary currents up to at least 120 μa (peak current density – 150 ma/cm^2), and is independent of energy at least in the range 6 to 30 Mev. With design modifications, the device should be capable of monitoring current at energies as low as 1 Mev with negligible beam absorption. (auth)

7714 FAST MOLECULAR NITROGEN BEAM. Nyle G. Utterback and Glenn H. Miller (Univ. of Denver). Rev. Sci. Instr., 32: 1101-6(Oct. 1961).

An apparatus is developed for producing a molecular N_2 beam covering the energy range 5 to 1000 ev. The technique includes ionization by electron impact, acceleration and focusing, and neutralization by charge transfer. Energy spread is 0.5 ev. The beam intensity ranges from 10^8 molecules per second at low energy to 10^{10} at high energy. The absolute beam intensity can be determined within 20%. Charge transfer efficiency, beam intensity monitoring, and adaptability of the apparatus to the studies of ionization cross sections and surface phenomena are discussed. (auth)

7715 RADIATION RESISTANT, REMOTELY OPERATED, HIGH CAPACITY SPRING BALANCE. J. E. Ayer and G. J. Pokorny (Argonne National Lab., Ill.). Rev. Sci. Instr., 32: 1114-16(Oct. 1961). (ANL-FGF-268)

A balance with a weighing range between 9 and 24 kg was tested. The use of radiation resistant sensing devices makes it acceptable for use in hot cell applications. With an unrefined read-out method the system sensitivity, including resolution of chart reading by eye, at 65% confidence limits is ±10 g in 2.5-kg intervals. Over the entire 9 to 24 kg range the linearity of the system is such that the sensitivity is reduced to ±17 g. It is predicted that digital indication of weight and use of a low inertia, low friction indicating system will double the system sensitivity. (auth)

7716 SOLID-STATE DETECTORS FOR HIGH RESOLUTION NUCLEAR SPECTROSCOPY. W. C. Parkinson (Univ. of Michigan, Ann Arbor) and O. M. Bilaniuk. Rev. Sci. Instr., 32: 1136-42(Oct. 1961).

Use of an array of solid-state detectors in conjunction with a magnetic analyzer as a replacement for nuclear emulsions in nuclear spectroscopy is described. Arrays of both Au–Ge and gold-doped silicon are used. The arrays consist of twenty detectors each and cover two inches along the image plane of the magnetic spectrograph. Particles of the same magnetic rigidity, but different mass, are easily identified as their energies are in the ratio Z^2/m. The silicon detectors, which operate essentially as parallel plate ionization chambers, suffer the disadvantage of becoming polarized. The use of such arrays reduces by a factor of the order of twenty the time required to extract precision data from a nuclear reaction. (auth)

7717 DESIGN OF RETARDING FIELD ENERGY ANALYZERS. J. Arol Simpson (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instr., 32: 1283-93(Dec. 1961).

Retarding field analyzers of the plane parallel plate, spherical condenser, Farady cage, and filter lens types are examined in some detail. The lens effect of the hole in the plane parallel plate through which the beam passes is shown to have a significant effect on the energy resolution. The analysis of the spherical condenser is extended to the hemispherical case, and the effect of the aperture in the inner sphere calculated. It is shown that for certain relations between the sphere sizes and the position of the source very high resolution may be obtained. The general restrictions on the performance of imaging retarding fields are considered, and a design procedure based upon empirical knowledge of immersion lenses is given. (auth)

7718 A 300-LITER HEAVY LIQUID BUBBLE CHAMBER. M. Bloch, A. Lagarrigue, P. Rancon, and A. Rousset (Ecole Polytechnique, Paris). Rev. Sci. Instr., 32: 1302-07(Dec. 1961).

A heavy liquid bubble chamber with a useful volume of 100 × 50 × 50 cm operating in a magnetic field of 20 kgauss is described. Engineering details are given. Lateral il-

lumination of the liquid and scattering of light at 90° is used to photograph the tracks. Different mixtures of Freon (CF_3Br) and propane are used in the chamber to allow a choice of radiation length and stopping power particularly suitable to the experiment performed. (auth)

7719 SIMPLE BROAD-RANGE MAGNETIC SPECTROMETER. James S. O'Connell (Univ. of Illinois, Urbana). Rev. Sci. Instr., 32: 1314-16(Dec. 1961).

The focusing properties are given of a broad-range magnetic spectrometer formed by inclined plane pole faces. (auth)

7720 NONOBSTRUCTIVE LOW ENERGY ELECTRON BEAM MONITOR. S. Okabe, T. Tabata, and R. Ito (Radiation Center of Osaka Prefecture, Japan). Rev. Sci. Instr., 32: 1347-8(Dec. 1961).

A modified type of secondary electron monitor useful for the monitoring of low energy electron beams during irradiation is described. Using the window foil at the end of the accelerator as a part of the detector, the monitor has a minimum disturbance on the primary beam. The monitor output is independent of the primary beam energy and proportional to the primary beam current in the range over which the monitor is tested (1.0 to 1.7 Mev and up to 120 μa). (auth)

7721 GENERATOR FOR PRODUCING HIGH CONCENTRATIONS OF SMALL IONS. K. T. Whitby (Univ. of Minnesota, Minneapolis). Rev. Sci. Instr., 32: 1351-5 (Dec. 1961).

An arrangement of a needle and a sonic orifice is developed that is capable of converting corona current into free small ions with 100% efficiency. Positive and negative ion concentrations of 10^{11} ions/cm^3 in the sonic jet and total ion outputs of 10^{14}/sec are achieved using 2.5 cfm of free air at 30 psig through a $^1/_{16}$-in. orifice. Theoretical and experimental studies of the ion decay rate in the jet show that the concentrations drop off approximately as the square of the distance from the ionizer. (auth)

7722 ČERENKOV RADIATION EXTENSIVE AIR SHOWER TELESCOPE. Forrest I. Boley and Norman H. Macoy (Wesleyan Univ., Middletown, Conn.). Rev. Sci. Instr., 32: 1359-62(Dec. 1961).

A telescope is described that is used to determine the directional characteristics of the Cherenkov radiation accompanying extensive cosmic ray air showers. The reflecting telescope has a 12.5-in. aperture, a 48-in. focal length and is of an off-axis design to permit the use of a 19-photomultiplier-tube light detection array. Pulse-height information from each tube is fed to separate, spaced inputs on a delay line which supplies the resulting signal for oscilloscope presentation. The various pulse heights provide the Cherenkov radiation directional information. An average of 75% of the Cherenkov photons arrive at the telescope within a half-angle of 2.3°. (auth)

7723 ACCURACY OF BUBBLE LOCATION IN A BUBBLE CHAMBER. Robert W. Williams (Univ. of Washington, Seattle). Rev. Sci. Instr., 32: 1378-80(Dec. 1961).

A measurement is reported of individual bubble locations along tracks of high-energy protons in a very small, short-time-scale pentane bubble chamber. Track distortions of the usual kind are greatly reduced in this system, so that measurements may be made, to a precision of a few microns, of the deviation of the true centers of the bubbles from the particle path. The average deviation in bubble position measurement is found from second differences to be 3.8 μ in space, most of which is shown to be accounted for by measurement errors. The average bubble is thus found to be centered on the track to better than 4 μ in hydrocarbons; however, an occasional bubble will be off by many times the average deviation. Arguments are advanced to show that a similar precision should obtain in hydrogen. (auth)

7724 DIFFUSE REFLECTION COATING FOR USE WITH ČERENKOV COUNTERS. Gerald L. Schnurmacher (Univ. of California, Berkeley). Rev. Sci. Instr., 32: 1380-2(Dec. 1961). (UCRL-9839)

A diffuse, highly reflecting coating for use with Cherenkov counters is described. This coating can be used inside inorganic-liquid Cherenkov counters, or can be used externally when bonded to the inside surface of the light-tight radiator cover. (auth)

7725 SIMPLE CIRCUIT FOR A PHOSWICH SCINTILLATION COUNTER. L. E. Peterson and J. H. Nitardy (Univ. of Minnesota, Minneapolis). Rev. Sci. Instr., 32: 1390-2(Dec. 1961).

A simple, transistorized circuit is described that analyzes the frequency composition of the photomultiplier current pulse from a phoswich scintillation counter. The circuit generates a gate waveform from the fast current pulse of an organic scintillator, but not from the slower pulse from an inorganic crystal. Such a circuit finds application when the phoswich is used to provide an anti-coincidence particle shield around a γ-ray spectrometer. (auth)

7726 IMAGE INTENSIFIER WITH ELECTRON-OPTICAL DEMAGNIFICATION USING COMBINED ELECTRIC AND MAGNETIC FIELDS. B. Zacharov (CERN, Geneva). Rev. Sci. Instr., 32: 1392-4(Dec. 1961).

A demagnifying image intensifier is proposed using parallel converging electric and magnetic fields. The design of such a tube is considered and calculations for the particular case of conical fields are presented. The diameter of a typical disk of confusion for a linear demagnification of 5 : 1 and minimum flux density of 10^{-2} weber/m^2 is found to be <0.004 cm. Suggestions are made for a tube incorporating an intermediate stage of electron multiplication. (auth)

7727 GAS TARGET FOR THE MULTIPLE-GAP, BROAD-RANGE SPECTROGRAPH. A. M. Hoogenboom (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 32: 1395-7(Dec. 1961).

A gas target with a very thin cylindrical window is developed for use with a multiple-gap, broad-range spectrograph. This gas target permits observation of reaction particles at all angles except zero and 180°. It may be used with a window thickness of 0.5 μ and a gas pressure of 1 cm Hg for (d,p) angular-distribution experiments with a 7.5-Mev, 0.5-μa deuteron beam. (auth)

7728 EFFECT OF ION RECOMBINATION LUMINESCENCE ON THE LINEARITY OF ENERGY RESPONSE OF GAS SCINTILLATION COUNTERS. A. J. Tavendale (Univ. of Tasmania, Hobart, Australia). Rev. Sci. Instr., 32: 1398-9(Dec. 1961).

The presence of columnar electron-ion recombination luminescence, from α particles and fission fragments in an argon gas scintillation counter having a few percent N_2 as waveshifter, is established. A decrease in luminescence yield with applied electric field indicates a loss of recombination luminescence by ion collection. For a U^{235} fission counter at two atomspheres pressure, a reduction in mean scintillation pulse height of 40% for fission fragments and 3% for background U^{234} alphas results at 1200 v/cm. It is concluded that columnar electron-ion recombination

luminescence accounts for the considerable nonlinearity of energy response observed in gas scintillation counters for heavily ionizing particles. (auth)

7729 LIGHT DETECTION SYSTEMS FOR LIQUID HELIUM SCINTILLATORS. S. V. Topp and F. L. Hereford (Univ. of Virginia, Charlottesville). Rev. Sci. Instr., 32: 1411-12(Dec. 1961).

The relative performances of various combinations of wave shifters, light pipes, and photomultipliers for use in conjunction with liquid He scintillators are studied. The use of quartz light collectors and ultraviolet-sensitive phototubes is found to be advantageous. Only α spectra are studied. (T.F.H.)

7730 APPARATUS FOR IN-PILE HALL COEFFICIENT AND CONDUCTIVITY MEASUREMENTS. Glenn C. Bailey and Conrad M. Williams (Naval Research Lab., Washington, D. C.). Rev. Sci. Instr., 32: 1412-13(Dec. 1961).

A compact, cylindrical, watertight assembly is described that contains a 500-gauss electromagnet, a system for holding the temperature constant at about 100°C, and an oxygen-depleted He atmosphere. The apparatus is used for in-pile measurements of Hall coefficients and conductivities of semiconductor samples. (T.F.H.)

7731 NUCLEAR PULSE SPECTROMETRY. Robert L. Chase. New York, McGraw-Hill Book Company, Inc., 1961. 227p. $8.50.

Thorough discussions are given of the electronic techniques and physical principles related to the problems of cataloging electrical signals from radiation detectors. In particular, the capabilities, limitations, operating principles, future prospects, and circuit design of radiation counters are analyzed. Information is given on such counter and ionization chamber devices as radio-assay and radiation-dose measuring devices that use Geiger counters, proportional counters, scintillation counters, and ionization chambers. Presented also are two types of spectrometric devices that take advantage of the relations between pulse-amplitude or pulse-detection time in these counters and incident particle energy. In addition, discussions are included on single-channel pulse-height analyzers, digital data storage systems, recording pulse-height-distribution data on photographic film, coincidence circuits, and the design of time delay and time-of-flight measuring systems. Helpful hints are provided for diagnosing and repairing spectrometer troubles. (N.W.R.)

7732 MEASUREMENTS WITH A DOUBLE PROPORTIONAL COUNTER ON NUCLIDES DECAYING BY ELECTRON CAPTURE. Pieter Kramer. Thesis, Amsterdam, Vrije Universiteit, 1961. 75p.

Weak interactions between nucleons and leptons in atomic nuclei are responsible for beta decay. Fundamental processes are discussed. Correlation effects and electron capture ratios for allowed and non-allowed transitions are examined. Comparisons of positron emission and K-electron capture are made, and rearrangement of the atomic cloud is discussed. Advantages and disadvantages of the beta spectrometer, the scintillation spectrometer, and the proportional counter are considered. Precision measurements on L/K capture ratios are performed for Ar^{37}, Fe^{55}, Ge^{71}, Kr^{79}, and I^{126}, and results are compared with theoretical calculations. Deviations are found. Improvements of K-fluorescence yield accuracies may be obtained from direct measurements using a proportional detector and determining separately the contributions of x-rays and Auger electrons. Design and construction of the apparatus are discussed. Measurements of K-capture fractions for Zn^{65}, Mn^{54}, and Co^{57} were made using the double proportional counter. Determinations of the K/β^+ ratio in Co^{58} decay and of the K-fluorescence yields for Mn^{54}, Fe^{55}, Zn^{65}, and Ge^{71} were made, and satisfactory values were obtained. (L.N.N.)

7733 IMPROVEMENTS IN RADIATION GAUGE. (to General Electric Co.). British Patent 886,634. Jan. 10, 1962.

A radiation gage for measuring the density or thickness of a test object is designed which uses an x-ray generating tube. The gage is stabilized against variation in the intensity of emitted x rays by regulation of the generating tube voltage, and the need for expensive wedge reference systems is avoided. The output of one of the detectors indicates the thickness or density of the test object. (D.L.C.)

7734 IMPROVEMENTS IN OR RELATING TO RATEMETERS. Edmund Harry Cooke-Yarborough (to United Kingdom Atomic Energy Authority). British Patent 887,043. Jan. 17, 1962.

A ratemeter for electrical pulses is designed in which radiation sources much stronger or weaker than a predetermined level are measured roughly over short times, e.g., in hand monitoring for alpha activity. The ratemeter comprises a store for receiving input pulses, means for emptying the store at a predetermined input rate irrespective of the actual input pulse rate, and means for detecting when the net stored pulse count has changed by a predetermined amount. The store is a storage capacitor of a Miller-type electronic integrating circuit, and the emptying means is a resistor which draws a constant current from the capacitor. (D.L.C.)

7735 IMPROVEMENTS IN OR RELATING TO IONISATION CHAMBERS. (to Philips Electrical Industries, Ltd.). British Patent 887,148. Jan. 17, 1962.

An ionization chamber which may be small in size, e.g., for personnel monitoring, is described wherein the wall of the chamber is made of vitreous boric oxide. Copper lead-in conductors extend through the wall and are coated with a soft vitreous enamel which forms an intermediate layer between the conductor surface and the wall material. The wall is coated with a layer of a polyester or celluloid impermeable to moisture. (D.L.C.)

7736 IMPROVEMENTS IN OR RELATING TO THE TESTING OF PIPELINES. (to Gelsenberg Benzin Aktiengesellschaft). British Patent 887,196. Jan. 17, 1962.

A radioisotope carrier is designed for the radiographic testing of a pipeline formed from pipe elements welded together end to end. The carrier is moved by pistons within the pipeline to bring the radioisotope into the plane of one weld for exposure of photographic film wrapped around the weld. The location of the carrier within the pipeline is facilitated by a tape attached to the carrier. (D.L.C.)

7737 IMPROVEMENTS IN OR RELATING TO EXTRUSION APPARATUS. (to Industrial Nucleonics Corp.). British Patent 887,265. Jan. 17, 1962.

An apparatus for extruding synthetic yarn is designed with a radiation source-detector arrangement to control the weight per unit length of the extruded fibers. (D.L.C.)

7738 IMPROVEMENTS IN AND RELATING TO ELECTRICAL CONTROL MEANS FOR DRAFTING APPARATUS. (to Industrial Nucleonics Corp.). British Patent 887,266. Jan. 17, 1962.

A mechanism for drafting textile fibers is designed with automatic control of the weight per unit length of the output sliver. The mechanism comprises two machine elements through which the workpiece passes in succession and a

radiation source-detector arrangement which regulates the speed of the second machine element to set the weight per unit length. (D.L.C.)

7739 IMPROVEMENTS IN OR RELATING TO CONTROL SYSTEMS. (to Industrial Nucleonics Corp.). British Patent 887,267. Jan. 17, 1962.

A system is designed for producing a control signal indicative of the deviation from a selected value of one physical or chemical property of the product of a continuous process. The property is measured by a radiation gage, and the system can be used in a variety of continuous process industries, e.g., rolling and extrusion processes. The standardization and calibration of the system is described in detail. (D.L.C.)

7740 IMPROVEMENTS IN AND RELATING TO CIGARETTE MAKING APPARATUS. (to Industrial Nucleonics Corp.). British Patent 887,268. Jan. 17, 1962.

A cigarette-making apparatus using a radiation gage to regulate the tobacco feed to a traveling paper is designed which avoids some of the disadvantages of previous devices, e.g., cumbersome standardization. A controller of the type described in British Patent 887,267 is used to compensate for the delay of corrective action by means of momentary overcorrection, and automatic means is provided for interrupting the control means whenever normal production of cigarettes is discontinued for any reason. (D.L.C.)

7741 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR THE MEASUREMENT OF SMALL DIRECT CURRENTS. Daniel Fraser Davidson, Edward Duncombe, and Wilfred Jacques (to United Kingdom Atomic Energy Authority). British Patent 888,362. Jan. 31, 1962.

An apparatus is designed for measuring and recording ion-beam currents on a logarithmic scale covering a number of decades so that the necessity for sensitivity adjustment is avoided. The apparatus comprises a reference terminal to which the current is fed, a load resistor connected between the reference terminal and a potentiometer slider, an electrometer, and a servomotor. The servomotor is actuated by the electrometer signal to adjust the slider so that the deflection of the slider gives a logarithmic indication of the current. (D.L.C.)

7742 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR THE MEASUREMENT OF MAGNETIC FIELDS BY MAGNETIC RESONANCE. Anatole Abragam, Jean Combrisson, and Ionel Solomon (to Commissariat a l'Energie Atomique). British Patent 888,439. Jan. 31, 1962.

A magnetometer utilizing magnetic resonance techniques is designed for measuring weak fields quickly and accurately. The apparatus is especially suitable for determining local variations of the earth's magnetic field, as in geophysical prospecting from an airplane. (D.L.C.)

Materials Testing

7743 (AGN-8045) ENGINEERING INVESTIGATIONS OF CENTRIFUGAL CREEP TESTING MACHINE. Progress Report (Report No. 5), July 1–November 30, 1961. J. Hull (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT(04-3)-368. 21p.

Progress is reported in equipment design and materials procurement for conducting creep tests on miniaturized Zircaloy-2 specimens, aluminum–iron alloys, and brittle materials. (B.O.G.)

7744 (NP-11270) THE FRACTURE ANALYSIS OF ALUMINA USING THE ELECTRON MICROSCOPE (thesis). Final Report. D. Tunison and V. Burdick (New York. State Univ. Coll. of Ceramics, Alfred). Nov. 30, 1961. Contract Nonr 2407(00). 40p.

With the aid of the electron microscope, a model system of pure hot pressed alumina was used to study the effect of temperature on the transverse strength and type of fracture in polycrystalline material. The type of fracture depends upon the relationship of crystalline to intercrystalline bond strengths, in particular, and it was found that these strengths were equal in hot pressed alumina at very nearly 1200°C. This is called the equicohesive temperature. The transverse strength decreased rapidly above the equicohesive temperature where the fracture was entirely intergranular. Samples of fused alumina made directly from bauxite were studied with the aid of the electron microscope and the metallograph in an attempt to relate the abrasive character of three types of this product to its microstructure. It was speculated that for high pressure grinding wheels of agglomerated fine-grained alumina would give a lower breakdown rate than the same sized monocrystalline grit used in a bonded abrasive wheel. (auth)

7745 (WAL-TR-142.1/1) DEVELOPMENT OF RADIOGRAPHIC TECHNIQUES FOR THE INSPECTION OF URANIUM TUBULAR SHAPES. Satrak Der Boghosian and Ernest H. Rodgers (Watertown Arsenal Labs., Mass.). Dec. 1961. 15p.

Various radiographic techniques were investigated for determining optimum techniques, using suitable radiation sources, in examining uranium tubular shapes. One-Mev resonance transformer and two-Mev constant potential radiographic units can be employed to yield 2 T radiography of the uranium tubular shapes as well as other uranium configurations. The data generated should prove useful in preparing inspection requirements for end item specifications. (auth)

7746 ULTRASONIC INSPECTION OF NOZZLE WELDS. R. F. Hanstock and R. F. Lumb (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Nuclear Power, 7: 77-9(Jan. 1962).

The possibility of inspecting reactor pressure vessel nozzle welds ultrasonically is investigated. Because of the large number of nozzles in reactor pressure vessels the aim is to develop a systematic method of examination at a practical rate with automatic recording of the ultrasonic response. To do this, high speed scanning is necessary with constant acoustic coupling between the weld and test probe. For these reasons, and to avoid probe wear, attention is directed exclusively to immersion techniques where the ultrasonic beam passes from the test probe to the weld through several inches of water. The method is feasible, but considerable latitude exists in respect of pattern of scanning, method of recording, and in rig design. (N.W.R.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

7747 (TEI-789) GEOLOGY OF THE 410 AREA NEVADA TEST SITE, NYE COUNTY, NEVADA. Robert E. Davis (Geological Survey, Washington, D. C.). June 1961. 26p.

The 410 Area occupies about 5 sq mi in the south-central part of the Nevada Test Site. General geologic and stratigraphic features are described. Data are tabulated on the porosity, density, permeability, hardness, unconfined compressive strength, and cesium exchange capacity of samples of the different rock types in the area. (C.H.)

7748 (UCRL-13031) SOURCES OF INFORMATION ON ROCK PHYSICS. Current Literature, December 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Dec. 29, 1961. For California. Univ., Livermore. Lawrence Radiation Lab. Contract [W-7405-Eng-48].

A literature review is presented on rock physics, rock mechanics, wave propagation, and other related subjects. The references are grouped under the following general topics: physical properties, rock deformation, loading, engineering applications, seismology, wave propagation, and instruments and methods. In each section the listings are arranged alphabetically by author. (M.C.G.)

7749 (WT-1513) SURFACE ALPHA MONITORING AS A METHOD OF MEASURING PLUTONIUM FALLOUT. R. E. Butler and H. M. Miller (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. Program 74 of OPERATION PLUMBBOB. 39p.

Alpha survey meter readings obtained on smooth, hard surfaces were correlated by chemical analysis with Pu concentrations in the immediate area of a one-point detonation of a weapon containing Pu. Results indicate an apparent decrease of surface contamination with time. (C.H.)

7750 (AEC-tr-4639) THE PURIFICATION OF AIR FROM RADIOACTIVE AEROSOLS. L. Lassen. Translated from Atomwirtschaft, 5: 511-18(1960). 26p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 9248.

7751 (AEC-tr-4851) RADIOACTIVE ISOTOPES IN THE EARTH'S CRUST. A. K. Lavrukhina. Translated from Khim. Nauka i Prom., 4: 472-8(1959). 21p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 2622.

7752 FISSION PRODUCT PRECIPITATION FROM THE ATMOSPHERE IN DEBRECEN, HUNGARY, BETWEEN 1958 AND 1960. A. Szalay and A. Kovach (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Acta Phys. Acad. Sci. Hung., 13: 281-7(1961). (In English)

Observations concerning the atmospheric precipitation of fission products were continued during 1958 to 1960. The cessation of nuclear test explosions Nov. 1958 made it possible to approximately measure the clean up rate of fission products in the atmosphere. A mean residence time of 0.45 years and a clean up half period of 0.3 years were observed. A reduction of fission product contamination of the atmosphere to one hundredth of its original value can be expected within two years. The clean up, therefore, is much quicker, and the rate of mixing between stratosphere and troposphere seems to be more intense than anticipated. The fission product contamination decreases to 10% of its original value within one year. In this reduction the effect of the mixing between the air masses of the stratosphere and troposphere and the radioactive decay are included. The mixing rate of the air masses of the stratosphere (or at least that of the lower layers of it) is about 75% per year. (auth)

7753 SOME PROBLEMS OF NUCLEAR METEOROLOGY. B. I. Styro. Atomnaya Energ., 11: 533-8(Dec. 1961). (In Russian)

The term "nuclear meteorology" is used to describe the study of geophysical problems connected with the radioactive contamination of the atmosphere and the solution of metereological problems by means of radioactive methods. This study is limited primarily to the natural radioactivity of the atmosphere. Many radioactive isotopes, such as H^3, Be^7, Be^{10}, C^{14}, Na^{22}, Si^{32}, P^{32}, P^{33}, S^{35}, Cl^{36}, Cl^{39} and A^{41} are formed in the atmosphere by the interaction of protons, neutrons and mesons of cosmic origin with N, O and A nuclei. The assumption that cosmic radiation is responsible for the creation of these isotopes is confirmed by the increase of their concentration with increasing altitude and by the latitude effect which coincides with the variation of the intensity of cosmic rays. The possibility of contamination of the atmosphere by radioactive materials carried by meteors is also taken into account. Weapons tests and industrial uses of atomic energy contributed Rn, Tn, C^{14}, Sr^{90}, Cs^{130}, I^{131} and other fission fragments; these materials may settle on the surface of the earth and on the oceans. The methods of investigation include freezing out, filtration, collection, activation, electroprecipitation, sedimentation, and dynamic studies with photoemulsions, each of which present certain advantages. The state of dispersion of aerosols must be determined as they act as transporting agents for certain materials, such as the Rn daughters. Individual "hot" particles with activities reaching 10^{-9} curie were detected by autoradiographic methods. Contamination of the atmosphere by weapons tests and by industrial uses makes it possible to study turbulence problems which are of great importance in reactor siting. (TTT)

7754 AERIAL PROSPECTING IN WOODED AREAS. A. V. Matveev. Atomnaya Energ., 11: 550-2(Dec. 1961). (In Russian)

In a previous paper (G. N. Kotel'nikov and N. I. Kalyakin, Atomnaya Energiya 8, 370(1960) No. 4), the shielding of γ-radiation by forests was incorrectly estimated and the conclusion was reached that aerial prospecting is not feasible under such conditions. This problem was further investigated by calculating the absorbing ability of pine trees which cover about 80% of the USSR forested areas. The calculations took into account the effect of the undergrowth and the foliage and derived mass absorption coefficients for the complex primary γ-ray spectrum and the Compton scattering of the U family of elements. Experimental tests were also carried out, comparing the intensity of the radiation of 2 similar areas by an aerial survey: one of the areas consisted of a pine forest, the other of a field near the edge of the woods. Co^{60} point sources were used for imitating the natural radiation; the flight was undertaken at 50-m height for safety reasons. The experimental data agreed well with the calculations and showed that the previous authors overestimated the shielding ability of the trees by factors ranging from 3 to 5. (TTT)

7756 URANIUM MIGRATION AND GEOCHEMISTRY OF URANIUM DEPOSITS IN SANDSTONE ABOVE, AT,

AND BELOW THE WATER TABLE. PART I. CALCULATION OF APPARENT DATES OF URANIUM MIGRATION IN DEPOSITS ABOVE AND AT THE WATER TABLE. John N. Rosholt, Jr. (Geological Survey, Denver). Econ. Geol., 56: 1392-1403(Dec. 1961).

The distribution of the daughter products is determined by radiochemical analyses of samples from ore deposits in sandstone, and the apparent minimum and maximum dates of uranium introduction or redistribution may be calculated from the Pa^{231}/Th^{230} ratio. The primary assumption required is that the protactinium and thorium do not migrate in measurable quantities from the place where they were produced by the decay of the parent uranium isotopes. The upper limit of age determination is about 250000 years, based on the half lives of Pa^{231} and Th^{230}. The difference in the half lives of these isotopes is reflected in their differential rates of growth and decay corresponding to migrations of the parent uranium during the time range considered. The growth and decay patterns, analyzed mathematically, are used to determine the apparent date of uranium migration. Calculations based on analyses of samples from the Hulett Creek area, Wyoming, illustrate the results for typical sandstone ore deposits that are above and at the water table. (auth)

7756 URANIUM MIGRATION AND GEOCHEMISTRY OF URANIUM DEPOSITS IN SANDSTONE ABOVE, AT, AND BELOW THE WATER TABLE. PART II. RELATIONSHIP OF URANIUM MIGRATION DATES, GEOLOGY, AND CHEMISTRY OF THE URANIUM DEPOSITS. Charles S. Robinson and John N. Rosholt, Jr. (Geological Survey, Denver). Econ. Geol., 56: 1404-20(Dec. 1961).

Data were obtained from uranium ore samples representing deposits above the water table, deposits just above and below perched water tables, and deposits at least 250 feet below the water table in the Hulett Creek area, Wyoming. The first uranium deposition occurred more than 250000 years ago for the deposits now at or above the water table. Approximately 60000 to 80000 years ago these deposits were oxidized, leached, and locally enriched. Accumulation of uranium in the deposits below the water table probably did not start before 180000 years ago and has continued to the present. (auth)

7757 URANIUM-BEARING BODIES IN THE ORE DEPOSITS OF TRAVERSELLA (ITALY). Stefano C. Zucchetti (Politecnico-Sezione Miniere, Turin). Econ. Geol., 56: 1469-71(Dec. 1961).

Analyses were made of radioactive ore deposits from the Traversella mine, which is in the northwestern Piedmont and more precisely in the Turin province. The radioactive mineral was found to be uraninite, thoriferous type. It occurs in isometric euhedral crystals, in polyhedric forms, both alone and in combination. The average specific gravity of the uraninites of Traversella is near 9. In transmitted light it appears opaque, even in very thin sections, but in polished sections it has a gray color, tending to brownish. The reflecting power is between 14 and 16%. The deposit is classified as contact metasomatic in a perimagmatic area. A quantitative analysis was made of the uraninite, and the data are given. (P.C.H.)

7758 OZONIZATION OF CHATTANOOGA URANIFEROUS BLACK SHALE. C. R. Kinney and J. T. Leonard (Pennsylvania State Univ., University Park). J. Chem. Eng. Data, 6: 474-6(July 1961).

Work on the oxidation of pyrite and organic matter of the shale by moist ozone is described. Information on the organic acids produced was obtained for possible industrial application. Pyrite was ozonized separately to establish its behavior uncomplicated by the presence of other constituents in the shale. In addition to iron sulfate salts and elemental sulfur, a part of the sulfur of the pyrite was oxidized to sulfur trioxide and was carried out by the oxygen stream. During ozonization of the shale, only carbon dioxide was evolved. Separation and purification of the organic matter were difficult. Purified kerogen was found to react readily with moist ozone with the evolution of carbon dioxide. After 48 hours of treatment, the sample was extracted successively with ether, water, and sodium hydroxide. The results of the infrared spectra of the ether-soluble acids show that ozonolysis of the kerogen of the Chattanooga shale converts over 60% of its carbon to water-soluble acids. These have molecular weights in the range of 200 to 400 and equivalent weights of about 120. Analyses of the products isolated and the distribution of the carbon of the kerogen in products are tabulated. (P.C.H.)

7759 RELEASE OF TECTONIC STRAIN BY UNDERGROUND NUCLEAR EXPLOSIONS. Frank Press and Charles Archambeau (California Inst. of Tech., Pasadena). J. Geophys. Research, 67: 337-43(Jan. 1962).

The strong excitation of SH waves and other phenomena associated with underground nuclear explosions suggest the hypothesis that pre-existing tectonic strain was released by the explosion. Pertinent evidence from the Rainier explosion is reviewed. A calculation of tectonic energy release is made for a simple model in which a spherical cavity is inserted in a prestrained medium. It is tentatively concluded that, although tectonic release does occur, its magnitude is probably too small to affect the character of seismograms. Experiments are suggested which could provide the basis for a better evaluation of the hypothesis. (auth)

7760 CESIUM 131 AND STRONTIUM 90 IN SEA WATER. Yasuo Miyake, Katsuko Saruhashi, Yukio Katsuragi, and Teruko Kanazawa (Meteorological Research Inst., Tokyo). J. Radiation Research (Japan), 2: No. 1, 25-8 (1961). (A/AC.82/G/L.686) (In English)

Concentration of Cs^{137} and Sr^{90} in the western North Pacific from 1959 to 1960 was determined. The content of Cs^{137} ranged from 0.8 to 4.8 $\mu\mu c/l$ while Sr^{90} of 0.6 to 3.1 $\mu\mu c/l$ was observed. These values are much higher than those obtained in the Atlantic and the eastern part of the North Pacific. The cause of higher contamination is due to the direct flowout of the fission product from the proving grounds in the tropical region of the Pacific. The reason for the lower ratio of Cs^{137}/Sr^{90} in sea water is also discussed. (auth)

7761 STRONTIUM 90 AND CESIUM 137 IN FALL-OUT DEPOSITS AND IMPLICATIONS OF THEIR RATIO. Masami Izawa (National Inst. of Radiological Sciences, Chiba, Japan), Hiroyuki Tsubota, and Takashi Nagai. J. Radiation Research (Japan), 2: No. 1, 29-41(1961). (A/AC.82/G/L.685) (In English)

Radioactivity in monthly fall-out, which had been collected by the pot method, was measured for Sr^{90} since October 1956 and Cs^{137} since August 1957. Total accumulated amount up to July 1960 was 15 mc/km^2 for Sr^{90} and 31 mc/km^2 for Cs^{137}. Distinct spring maxima of fall-out rate was observed on May 1959 and 1960. Ratio of the total activities of Cs^{137} and Sr^{90} since August 1957 were 2.8, which is higher than the assumed ratio from nuclear fission processes, and ratio Cs^{137}/Sr^{90} vary considerably from month to month (1.8 to 8.2). The high observed ratio can be explained mainly from the differences in the half lives of the ancestor radionuclides of Sr^{90} and Cs^{137}, i.e.,

Kr^{90} (33 sec) and Xe^{137} (3.9 min), respectively, while monthly variation of the ratios can be explained from meteorological conditions in the rain-bearing layer of troposphere. (auth)

7762 ABSOLUTE ISOTOPIC ABUNDANCE OF TERRESTRIAL SILVER. William R. Shields, Ernest L. Garner, and Vernon H. Dibeler. J. Research Natl. Bur. Standards, 66A: 1-3(Jan.-Feb. 1962).

Isotopic abundance ratios are reported for a commercial silver nitrate, 13 samples of native silver, and 11 silver minerals of various compositions and from widely distributed deposits. Collateral measurements of known mixtures of nearly pure silver isotopes permit the determination of absolute abundance ratios. Native silver from Cobalt, Ontario, previously reported as exhibiting statistically significant variation, was re-examined. Additional measurements are reported for samples from the same nugget and from the same region. Except for the original observation, no significant variation from normal abundance was observed for any of the samples. The Ag^{107}/Ag^{109} ratio obtained from pooling the data is 1.07597 with a 95% confidence limit of ± 0.00055 for the effect of random errors and a total uncertainty of ± 0.00135 when an allowance for the possible effects of known sources of systematic error is included. (auth)

7763 ORIGIN OF HIGH TRITIUM CONTENT OF ATMOSPHERIC METHANE, HYDROGEN AND STRATOSPHERIC WATER. Richard Wolfgang (Univ. of California, San Diego and La Jolla). Nature, 192: 1279-80(Dec. 30, 1961).

Discussion is given on the hypothesis that tritiated methane may be produced in the fireball of a bomb, in a reducing atmosphere. Following detonation of a bomb, the hot gas formed from bomb material pushes back the surrounding atmosphere to form a reducing core within the fireball. On cooling to about 3000°C, the core contracts to a diameter approaching 100 meters, assuming some reasonable mass of the original weapon. During this state the fireball is isothermal, and it is likely that the large reducing core will mix with its oxidizing surroundings. On further cooling its contents will form molecular species. The tritium may be expected to combine largely as metal hydrides, molecular hydrogen, water, ammonia, and hydrocarbons including methane. The hypothesis of a reducing core in a nuclear explosion fireball also suggests that the high tritium content of atmospheric hydrogen of the thermonuclear era arises directly, and is not dependent on an exchange between molecular hydrogen and tritiated water. Suggestions are given for checking the validity of the hypothesis. (P.C.H.)

7764 RADON IN THE UPPER ATMOSPHERE. Lester Machta (U. S. Weather Bureau, Washington, D. C.) and Henry F. Lucas, Jr. Science, 135: 296-9(Jan. 26, 1962).

Results are presented of measurements of radon concentrations in the atmosphere at altitudes up to 80,000 ft, these were made near the equator and in the polar regions. The observations, combined with the vertical profiles of ozone and fission products whose origin is the stratosphere, suggest that a rising motion, rather than turbulent mixing, is the more likely mode of transfer in the upper atmosphere. (C.H.)

7765 MINERALS FOR THE CHEMICAL AND ALLIED INDUSTRIES. Second Edition. Sydney J. Johnstone and Margery G. Johnstone. New York, John Wiley & Sons Inc., 1961. 797p. $25.00.

A concise account is given of the sources, nature, modes of occurrence, and methods of treatment of all industrial minerals (except the hydrocarbons) and products derived from them, together with typical specification requirements for their commercial use. There are comprehensive bibliographies. Special attention is given to the information on minerals used in nuclear fission plants. (N.W.R.)

7766 ON THE DISTRIBUTION OF GAMMA RAY INTENSITY DUE TO NATURAL RADIOACTIVITY NEAR THE EARTH'S SURFACE. Shun-ichi Sano (Japan. [Industrial Science and Technology Agency]. Geological Survey, Kawasaki). 1961. 44p.

The inverse-square exponential law for a point isotropic source combined with a linear build-up factor was applied in calculating the gamma intensity in the air and in a drill hole. Measurements were performed on broad, thick, and slab sources, using the proper transformations. The intensity-altitude relation was obtained, and intensity distributions from a horizontal radioactive layer were calculated. Products of the grade and thickness of the horizontal ore-bearing bed, which are necessary for an estimation of the ore reserves, were obtained by integrating the intensity in the drill hole with respect to depth, but are independent of the hole diameter and dynamic character of the rate meter. (L.N.N.)

HEALTH AND SAFETY

Refer also to abstracts 7373, 8395, 8396, 8400, 8401, 8402, 8403, 8405, 8406, and 8424

7767 (DC-59-9-223) HAZARDS OF ZIRCONIUM. J. J. Roseman (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 28, 1959. Contract AT(11-1)-171. 17p.

Results are summarized from an extensive literature survey of possible safety hazards in the processing of zirconium. In general it was determined that massive zirconium is very stable in the presence of many chemical solutions. However, a serious safety hazard does exist with zirconium powders, machining residues, acids that rapidly attack the metal, and alloys of uranium. Recommendations are made for the handling of zirconium. 19 references. (auth)

7768 (DXRL-1) FALLOUT IN NEW ZEALAND. Results to June 1961. (New Zealand. Dominion X-Ray and Radium Lab., Christchurch). Oct. 31, 1961. 24p.

The current position in New Zealand with respect to fall-out is summarized and an evaluation of the health hazard is offered. The fall-out program is described including its sampling stations and their operations. The fall-out mechanism is described, and properties of the hazards are given. Results are tabulated for Sr^{90} in rain, soil, and milk as far back as 1953. (T.R.H.)

7769 (NDL-TR-18) EFFECT OF NEUTRON INTERACTIONS WITH SOIL ON MEASURED GAMMA DOSE. Robert J. Smith and Ralph F. Benck (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). Nov. 1961. 36p.

A method of calculating the gamma dose arising from neutron interactions with soil is described. Examples are presented and compared with initial gamma field dose rates. Depending on the distance, the gamma contribution from the soil can be a major or minor donor to the initial gamma dose. (auth)

7770 (NP-11066) SAFEGUARD REPORT OF FiR 1. Pekka Jauho, Bjarne Regnell, Sakari Valve, and Jouko Virkkunen, eds. (Finland. Teknillinen Korkeakoulu, Otaniemi). July 1960. 63p.

An analysis was made of the hazards that might arise in the operation of the FiR-1 reactor of the type TRIGA Mark II in Otaniemi. It was assumed that the reactor was operating at a constant power level of 100 kw. Information concerning the population and conditions in the surroundings of the reactor site pertaining to the prediction of the effects of war, sabotage, or other corresponding incidents are included. (M.C.G.)

7771 (NP-11191) PROCEDURES FOR THE ESTIMATION OF THE CONCENTRATION OF NUCLEAR WEAPON FALLOUT IN RIVER WATER. Wallace O. Wade and Myron B. Hawkins (California. Univ., Berkeley. Inst. of Engineering Research). Oct. 2, 1961. Contract CD-SR-58-40. 27p.

Fall-out contamination of surface water supplies presents a potential hazard after a nuclear attack. The internal radiation dose received from consumption of fall-out-contaminated water may be estimated from the known concentration of fall-out in the water and the radiological character of the fall-out material. A simple and direct method is presented of estimating for a river water supply the concentration of stream surface deposited fallout arriving at the intake. The method utilizes stream data available from offices of the Surface Water Branch of the United States Geological Survey. Sample calculations and graphical aids are included. (auth)

7772 (TID-14647) HEALTH PHYSICS CONSIDERATIONS FOR THE DISPOSAL OF NON-ENRICHED URANIUM CHIPS BY BURNING. Merwyn Sanders (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). [nd]. Contract [W-7405-eng-26]. 5p.

Several possible methods of disposal of low-level pyrophoric uranium chips from machining operations were considered, and burning was chosen for tests. Uranium chips were burned in an isolated area 1.25 miles from the nearest occupied area, and air was monitored in all directions at varying distances from the test site. The air monitoring results indicate that burning is a safe method of disposal for uranium chips. (D.L.C.)

7773 (TID-14742) RADIOISOTOPE TECHNOLOGY. Manual for AEC-NSF Institute. Lloyd E. Brownell (Michigan. Univ., Ann Arbor). June 1961. Contract [AT(11-1)-975]. 574p.

Principles of radioisotope technology are reviewed from the standpoint of radiation protection during scientific and industrial applications of radiation. Topics discussed include safety in work with radioisotopes, the design and use of radiation laboratories, nuclear radiation detection and measurement, methods of radiation dosimetry, counting equipment, gamma shielding, experimental techniques in tracer studies, and experiments in radioisotope technology. (C.H.)

7774 (AEC-tr-4629) CONTROL OF ATMOSPHERIC CONTAMINATION IN THE LABORATORIES OR SHOPS. E. Mestre. Translated from Bull. inform. sci. et tech. (Paris), No. 43, 32-43(1960). 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract No. 9250.

7775 (JPRS-11623) RADIOACTIVITY OF EXTERNAL MEDIUM IN THE ENVIRONS OF GREATER WARSAW AND SWIERK. W. Hermanowicz, C. Sikorowska, W. Dozanska, J. Kelus, K. Kosinski, J. Luczak, and M. Marciszewska-Szoplik. Translated from Gaz, Woda i Tech. Sanit., 35: No. 9, 340-7(Sept. 1961). 24p.

Studies were made during 1959 of the environmental radioactivity in the environs of Warsaw and Swierk, Poland. Results of the studies will constitute a basis for exploring the background radioactivity and changes taking place as a result of disposal of radioactive wastes or other environmental contamination. Results are given from extensive measurements on air, water, and soil. (C.H.)

7776 BEHAVIOUR OF IODINE VAPOUR IN AIR. A. C. Chamberlain, A. E. J. Eggleton, W. J. Megaw, and J. B. Morris (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Discussions Faraday Soc., No. 30, 8p. (1960).

Experiments with radioiodine vapor at volumetric iodine concentrations below 1 $\mu g\ m^{-3}$ in the containment shells of the reactors Dido and Pluto showed rapid adsorption on the walls and other surfaces. Adsorption on atmospheric nuclei was also an important factor and must be allowed for in designing iodine removal systems. There was also some evidence of the formation of a gaseous compound of iodine.

When iodine vapor equilibrates with air, nuclei, and permanent surfaces over a period of hours, the proportion of the airborne iodine, which is elemental iodine vapor, becomes small and the rate of removal slow. (auth)

7777 THE HAZARDS OF RADIATION. Edward Teller. J. Nuclear Med., 3: 1-9(Jan. 1962).

Discussion is given on radioactive fall-out and the genetic effects of radiation. The subjects are discussed from the nuclear medicine point of view, and some positive aspects of nuclear medicine are emphasized. In particular, scientific results, which are misunderstood, are evaluated. (P.C.H.)

7778 LOW ACTIVITY MEASUREMENT IN WATERS. [PART] IV. Jarmila Rálková (Inst. of Nuclear Physics, Prague). Jaderná energie, 7: 374-7(1961). (In Czech)

A problem of low radioactivity measurement in waters and difficulties connected with this measurement are discussed. Tables of radioisotopes, which may be contained in waste, river, and drinking waters, are enclosed. (auth)

7779 THE ENVIRONMENTAL EFFECT OF NUCLEAR INSTALLATIONS. František Běhounek (Czech Tech. Univ., Prague). Jaderná energie, 7: 397-400(1961). (In Czech)

Radioactivity penetration into the biosphere, i.e., into air, water, and soil, is considered. The influence of reactor location, the importance of systematic radiation monitoring before reactor construction and after operation, and the most convenient method of radiation measurement in the environment during reactor operation and after an incident are discussed. (auth)

7780 CONTROLLING TRANSMUTATION PRODUCTS OF RADON IN THE ATMOSPHERE. Josef Thomas (Inst. of Industrial Hygiene and Radiation Protection, Prague). Jaderná energie, 7: 408-10(1961). (In Czech)

Biological effects of inhaled radon decay products in the first approximation are proportional to the latent energy of alpha radiation of all decay products of radon. It is possible to determine this value by a method using beta radiation of decay products of radon. Detection efficiency seems to be changed with time only; however the change is insignificant even in various degrees of equilibrium disorder of radon transmutation products. The method is a modification of Kusnetz's method for alpha radiation of transmutation products of radon. (auth)

7781 MEASUREMENTS OF STRONTIUM-90 IN THE AUSTRALIAN ENVIRONMENT UP TO DECEMBER 1960. F. J. Bryant (Atomic Energy Research Establishment, Harwell, Berks, Eng.), L. J. Dwyer, D. J. Stevens, E. W. Titterton, and J. R. Moroney. Nature, 193: 188-9(Jan. 13, 1962).

The Sr^{90} contents in human bone tissue samples collected from the five capital cities of Australia in the period July to December 1960 are tabulated. The contents are all less than 1.5 $\mu\mu c$ Sr^{90}/g Ca, $\frac{1}{3}$ to $\frac{1}{2}$ of those for U. K. and U. S. Sr^{90} contents are summarized for milk, cabbages, wheat, flour, soil, and precipitation in 1959 and 1960. The per capita mean daily intake of Sr^{90} is estimated to be 4.5 $\mu\mu c$ Sr^{90}/g Ca. (D.L.C.)

7782 DEPOSITION OF Cs-137 AND Sr-90 IN TOKYO. Y. Miyake, K. Saruhashi, Y. Katsuragi, and T. Kanazawa (Meteorological Research Inst., Tokyo). Papers Meteorol. and Geophys. (Tokyo), 12: No. 2, 2p.(1961). (A/AC.82/G/L. 688) (In English)

Data are tabulated on the monthly amounts of Cs^{137} and Sr^{90} deposited in Tokyo during the period from April 1957 to December 1960. (C.H.)

7783 MONITORING THE ENVIRONMENT OF NUCLEAR-TECHNICAL INSTALLATIONS. Kurt Juergen Vogt (Kernforschungsanlage, Julich, Ger.). Röntgen Bl., 14: 389-96(Dec. 1961). (In German)

General outlines are given for an optimum monitoring system, which is able to control the adherence to official directives issued for radiation protection and to indicate the radioactive state of the environment. Using the nuclear research installation Jülich as an example, a monitoring program, which utilizes these principles to a wide extent, is discussed. (auth)

7784 NEW METHODS OF DUST COLLECTION BY SYNTHETIC FILTER AIDS. Erich Kniep. Wasser, Luft u. Betrieb, 5: 47-50(Feb. 1961). (In German)

Dusts may be classified into natural and synthetic, according to their origin. Most concerned with dust collection are the clay, mining, chemical, metallurgical, coal, gas, iron and steel, and food industries. The properties of various synthetic fibers which make them suitable for use in dust collectors are discussed. The synthesis of the filter tissue is then reviewed. (J.S.R.)

7785 TESTS WITH AND USE OF ELECTROSTATIC PRECIPITATORS. Werner Jessnitz. Wasser, Luft u. Betrieb, 5: 51-4(Feb. 1961). (In German)

Cross sections of various commercial electrofilters are shown, and their performances are reviewed. (J.S.R.)

7786 STOPPING POWERS FOR USE WITH CAVITY CHAMBERS. Stopping Power Study Group. Subcommittee M-3 Standards and Measurements of Absorbed Radiation Dose. Recommendations of the National Committee on Radiation Protection and Measurements. NCRP Report No. 27. (National Bureau of Standards, Washington, D. C.). National Bureau of Standards Handbook 79. Sept. 1, 1961. 90p. $0.35(GPO).

A critical review is presented of literature on the stopping power ratio used in the interpretation of cavity ionization measurements in radiation dosimetry. Values for the stopping power ratio are necessary in order to obtain the energy absorbed in the wall of a cavity chamber from measurements of the ionization produced in the gas of the cavity. The stopping power ratios are also needed in the determination of the exposure dose from ionization measurements in a cavity chamber. The discussion places particular emphasis on gamma and x radiations with only occasional reference to beta radiation, electron beam radiation, and neutrons. The review is concerned with practical applications, cavity chamber theory, and stopping power ratios that are considered the most accurate. (N.W.R.)

7787 PROTECTIVE MEASURES IN CONNECTION WITH ELECTROMAGNETIC SEPARATIONS OF RADIOACTIVE ISOTOPES AT THE OAK RIDGE NATIONAL LABORATORY. L. O. Love, W. A. Bell, J. E. Keeton, W. R. Prater, and F. M. Scheitlin (Oak Ridge National Lab., Tenn.). p.257-67 of "E. M. Separation of Radioactive Isotopes. Proceedings of the International Symposium, Vienna, May 1960." Vienna, Springer-Verlag, 1961. (In English)

Discussion is given on the methods and equipment used in an attempt to achieve total containment of plutonium, allowing personnel maximum freedom from discomfort in work areas. The element is contained totally within the operating units, which are calutron vacuum tanks, processing glove boxes, and wash facilities. The rooms in which chemical feed recycle, product refinement, and unit

wash are performed are maintained at negative pressure and both inlet and exhaust air is subjected to fiber-glass and absolute filters, respectively. Protective clothing is also worn in all areas where plutonium contamination is reasonably possible, and personnel monitoring is performed continually during all transfer and unit wash operations. (P.C.H.)

7788 CRITICALITY CONTROL IN CHEMICAL AND METALLURGICAL PLANT. KARLSRUHE SYMPOSIUM, 1961. (European Nuclear Energy Agency, Paris). 1961. 625p. $10.00(ENEA).

Separate abstracts have been prepared for 19 of the 22 papers presented at the symposium. Seventeen papers are in English and 5 are in French. The 3 papers not abstracted separately have been previously abstracted in NSA. (T.F.H.)

7789 FUNDAMENTALS OF CRITICALITY CONTROL. E. R. Woodcock (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.15-46 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

An outline is presented of the suitability and accuracy of various parameters that may be used to determine the closeness of a given assembly to criticality. The physical processes governing criticality are reviewed. Principles that can be used in plants to assure criticality safety (e.g. mass control, geometrical control, and concentration control) are discussed. (T.F.H.)

7790 SURVEY OF THEORETICAL CALCULATION METHODS. R. T. Ackroyd (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.) and E. D. Pendlebury. p.47-118 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (DEG-Report-362). (In English)

Monte Carlo and transport theory methods for calculating the criticality parameters of heterogeneous and homogeneous assemblies are compared, as regards the methods' respective complexities, accuracies, applicabilities, and the insight they offer into the physical situation. A number of formulations of transport theory are employed. The systems studied include single geometrically simple vessels, assemblies of these vessels, and more complicated geometries. (T.F.H.)

7791 THEORETICAL METHODS USED IN CRITICALITY CALCULATIONS. P. Benoist, R. Caizergues, C. Clouet d'Orval, and B. Duchemin (Commissariat à l'Energie Atomique, Saclay, France). p.119-35 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In French)

Theoretical means for calculating the criticality characteristics of fissionable systems are reviewed. Systems in which two-group theory may be used (aqueous thermal solutions, pure fast systems, fast systems reflected by hydrogenous materials, etc.), as well as systems in which multigroup theory must be employed (more complex intermediate or fast systems, moderated systems, etc.), are discussed. The case in which the system is unreflected is found to be reducible to a simple calculation. The philosophy of overestimation of the criticality conditions is reviewed. (T.F.H.)

7792 A REVIEW OF CRITICALITY DATA OBTAINED BY EXPERIMENTAL METHODS. D. Callihan (Oak Ridge National Lab., Tenn.). p.139-72 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

Experimental data obtained for the purpose of determining criticality parameters of fissionable materials outside reactor environments are surveyed, with emphasis on U^{233}, U^{235}, and Pu^{239}. The data on U^{235} are mainly in the enrichment ranges <5 and >90%. The data on U^{233} and Pu^{239} are restricted to metallic units and aqueous solutions within a small range of chemical concentrations. The assemblies studied are assumed to be spherical. The operating conditions assumed are those expected in chemical and metallurgical processing plants. (T.F.H.)

7793 SAFE-BY-SHAPE CHEMICAL PLANTS. K. M. Hill and H. E. Parker (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.209-31 of "Criticality Control in Chemical and Metallurgical plant." Paris, European Nuclear Energy Agency, 1961. (In English)

Design problems in the safe-by-geometry type of processing plant are described, and the technological status of this type of plant is outlined. Safety problems associated with the connections between safe-geometry and unlimited-geometry equipment are stressed. (T.F.H.)

7794 CONCENTRATION CONTROL AND ITS APPLICATIONS. J. Gunther (Commissariat à l'Energie Atomique, Paris). p.233-49 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In French)

Theoretical and industrial aspects of concentration-control methods for criticality safety in out-of-pile assemblies, are reviewed. Particular attention is devoted to criticality control in aqueous solutions or mixtures, for various geometrical arrangements. Methods for calculating acceptable concentrations for various industrial processes are discussed. (T.F.H.)

7795 HOMOGENEOUS AND HETEROGENEOUS POISONING AS POTENTIAL METHODS FOR CONTROLLING CRITICALITY. J. W. Wachter (Union Carbide Nuclear Co., Oak Ridge, Tenn.). p.289-314 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

The administrative control, cost, and nuclear safety considerations involved in the use of fixed and soluble poisons in the processing of fissionable materials are outlined. The fixed poisons considered include boral plates, borosilicate glass pipes and rings, metal sheaths for process tanks, Raschig rings, etc. Attention is devoted to such aspects as loss of poison, e.g. by precipitation; product contamination by the poison; and the effects of the process environment on the poison. The cases are considered in which the poisons are used as primary, secondary, and contingent control methods. (T.F.H.)

7796 STUDY OF A HETEROGENEOUS POISONING METHOD AND ITS APPLICATION. R. Caizergues (Commissariat à l'Energie Atomique, Saclay, France). p.315-41 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In French)

A heterogeneous poisoning method for cylindrical containers holding aqueous solutions of fissionable materials is developed. An infinite lateral water moderator is assumed. The cases are studied in which the fissionable material remains in solution or is liable to precipitation. The method consists of the addition of a number of radial poison vanes, which may extend partially or completely across the container. (T.F.H.)

7797 A TYPICAL MANUFACTURING PLANT FOR ENRICHED UO_2 FUEL ELEMENTS. J. W. Wachter and W. T. Mee (Union Carbide Nuclear Co., Oak Ridge, Tenn.). p.345-66 of "Criticality Control in Chemical and Metal-

lurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

General criticality-control considerations involved in feasibility and cost analyses, equipment design, engineering layout, construction, and startup and routine operations of a fissile-material processing plant are reviewed. A typical process line for the production of 5%-enriched UO_2 fuel elements from a UF_6 feed material is described, and the nuclear safety considerations applicable to the operations of each type of process unit are discussed. (T.F.H.)

7798 METHODS OF CALCULATION FOR INTERACTING ARRAYS, WITH SPECIAL REFERENCE TO STORAGE PROBLEMS. R. T. Ackroyd, F. R. Charlesworth, and A. F. Thomas (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.395-432 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

Control of criticality in arrays of interacting fissionable bodies is discussed, with special emphasis on storage problems. Both well-defined and ill-defined arrays are considered. Empirical theoretical (e.g. the Oak Ridge method, the density analog, and Kenyon's rules) and (e.g. the unified theory method and the interaction parameter method) approaches to the problems, as well as combinations of these approaches, are studied. (T.F.H.)

7799 CRITICALITY ASPECTS OF THE TRANSPORT OF FISSILE MATERIALS—THE TECHNICAL BASIS OF THE PROPOSED I.A.E.A. REGULATIONS. R. F. Barker (International Atomic Energy Agency, Vienna). p.433-9 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

International Atomic Energy Agency (IAEA) regulations intended to insure criticality safety in the transport of fissile materials, high-activity materials, and low-activity radioisotopes, ores, and residues are reviewed. The regulations are also concerned with other effects of radioactivity, such as heat generation and ionizing radiation. (T.F.H.)

7800 PRESENTATION OF "CRITICALITY ASPECTS OF THE TRANSPORT OF FISSILE MATERIALS." M. C. Erginsoy (International Atomic Energy Agency, Vienna). p.441-55 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

The details of the proposed I.A.E.A. regulations concerning transport of fissile materials are summarized. The construction of containers for these materials is described, and the safety criteria followed in arriving at the regulations are outlined. (T.F.H.)

7801 ADMINISTRATIVE ASPECTS OF CRITICALITY CONTROL. P. Lecorche and R. Caizergues (Commissariat à l'Energie Atomique, Saclay, France). p.459-63 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In French)

The program followed by the French Commissariat a l'Energie Atomique (CEA) for the administrative control of nuclear safety in processing plants is discussed. The general rules as applied to industrial and semi-industrial plants, and to laboratory installations (especially those handling Pu and enriched U), are reviewed. Control of Pu concentrations by neutron counting, and of U concentrations by γ counting, is outlined. (T.F.H.)

7802 ORGANIZATION FOR OPERATIONAL CONTROL OF CRITICALITY. H. Howells and J. T. Daniels (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). p.465-76 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

Governmental procedures followed in the United Kingdom for administratively assuring nuclear safety in installations handling fissionable materials are outlined. The requirements and means by which an operator obtains an official operating clearance are reviewed. The governmental policies for inspection, theoretical and design studies, pre-commissioning trials, and clearance processing are outlined. The operator is required to give consideration to various contingencies that may arise, to furnish accident safeguards and procedures, and to provide personnel safety training. (T.F.H.)

7803 ADMINISTRATIVE AND OPERATIONAL NUCLEAR SAFETY CONTROLS IN A CHEMICAL PROCESSING PLANT. C. L. Schuske (Dow Chemical Co., Denver). p.477-90 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (RFP-224). (In English)

The administrative policies followed by the U. S. Atomic Energy Commission to insure operational control of nuclear safety in prime contractor plants (those owned by the AEC and operated by private industry) and in licensee plants (those owned and operated by private industry) are reviewed. An outline is presented of the methods used to assign responsibility for safety, and to set procedures and methods. Safety training programs for supervisory and non-supervisory personnel are outlined. Instrumentation available for criticality alarms and for U and Pu process concentration control is discussed. (T.F.H.)

7804 A REVIEW OF CRITICALITY INCIDENTS. W. R. Stratton (Los Alamos Scientific Lab., N. Mex.). p.491-533 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

An account is presented of 24 accidental criticality incidents. The dates, locations, active materials, geometries, number of fissions, resulting damage, maximum reactivities achieved, and other important data on the incidents are given. The incidents are classed as follows: 8 in water solutions of U^{235} or Pu^{239}; 5 in metal assemblies in air; 7 in inhomogeneous H_2O- or D_2O-moderated systems; and 4 in other configurations. (T.F.H.)

7805 ORGANIZATION OF EXPERIMENTAL CRITICALITY RESEARCH. J. Bertrand, D. Breton, R. Caizergues, C. Clouet d'Orval, E. Deilgat, M. Molbert, and P. Verriere (Commissariat à l'Energie Atomique, Saclay, France). p.537-52 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In French)

The organization and experimental programs at the French criticality laboratories at Saclay and Dijon are described. The homogeneous reactor PROSERPINE, and its related critical experiment ALECTO, are discussed. The experimental efforts regarding unusual storage methods for Pu, and problems posed by U^{235}, are emphasized. (T.F.H.)

7806 THE EQUIPMENT AND METHODS USED IN BRITISH CRITICALITY LABORATORIES. J. G. Walford and A. F. Thomas (United Kingdom Atomic Energy Authority, Caithness, Scotland). p.553-88 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

The experimental equipment and operational procedures at the Aldermaston, Dounreay, and Harwell criticality

laboratories are described. The various types of experiments carried out at these facilities are outlined. Special attention is given to experiments on all-solid and all-liquid systems. (T.F.H.)

7807 EXPERIMENTS FOR CRITICALITY CONTROL. D. Callihan (Oak Ridge National Lab., Tenn.). p.589-614 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961. (In English)

A discussion is presented of the types of experiments that yield information for solving criticality problems. The experimental methods, laboratory and equipment requirements, and personnel requirements encountered in the U.S. are outlined. Areas in which experimental information is deficient are summarized. (T.F.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

7808 (HW-66600) IONIUM, URANIUM-232, AND THORIUM-228 PROPERTIES, APPLICATIONS AND AVAILABILITY. Charles A. Rohrmann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1960. Contract [AT(45-1)-1350]. 31p.

Charts are given which present information on the properties, sources, and uses of Th^{230}, Th^{228}, and U^{232}. They also compare these properties with competitive isotopes. (M.C.G.)

7809 (NYO-9849) UTILIZATION OF RADIOACTIVE ISOTOPES IN COAL PROCESS RESEARCH. Quarterly Technical Status Report No. 10, September 1, 1961–November 30, 1961. P. M. Yavorsky and E. Gorin (Consolidation Coal Co. Research and Development Div., Library, Penna.). Jan. 1, 1962. Contract AT(30-1)-2350. 18p.

Experiments are continuing to determine the cleaning efficiency and rate of cleaning of fine size bituminous coals by the water fluidization method. By radio-tracing neutron activated pyrites, data were obtained on the rate of segregation of mineral impurities from the coal as a function of particle size and density in a 48 × 0 mesh hydraulic fluidized coal bed. Two methods of radio-tracing were demonstrated. The ultimate cleaning efficiency of the above size coal is also reported. (auth)

7810 (RAI-200) THE TECHNOLOGY AND APPLICATIONS OF LARGE FISSION PRODUCT BETA SOURCES. Quarterly Report for the Period October 1 to December 31, 1961. Jacques J. Weinstock, Ella Y. Microcznik, and Kenneth D. Ziegel (Radiation Applications Inc., Long Island City, N. Y.). Jan. 18, 1962. Contract AT(30-1)-2186. 50p.

Developments are reported in the development and testing of methods and materials for the fabrication of large, rugged, and safe β radiation sources and the development and demonstration of process applications for such sources. The composition and acid solubility of a non-active enamel containing Sm oxide are reported. This formulation was used for the preparation of Pm^{147} enamel. The effect of furnace atmosphere during firing on the acid solubility of Ce oxide enamel was investigated. The mechanical impact resistance of non-active Ce enamel was improved by using −200 mesh powder for coating of slides rather than the −100 + 200 mesh previously employed. No effect on thermal and mechanical shock resistance of Ce, Sr, and Sm enamels was observed after irradiation to 10^{10} rads with 1.0-Mev electrons. The performance of Ce enameled slides in various electrolytic solutions was investigated. New techniques were employed to produce samples of non-active enamel supported by a wire mesh structure as part of a study to improve the efficiency of vitreous enamel β sources. A 150-gm batch of enamel containing 900 mc of Pm^{147} was prepared and used to prepare active pellets and slides for leach and dosimetry studies. Leach test data are presented for Ce enamels with Ce^{144} tracer and for Pm^{147} enamel. The equations for dosimetry of small Ce^{144}–Pr^{144} sources were revised using more accurate data for the average β energy. A preliminary engineering design and cost estimate are presented for a research β irradiator. This unit would use 5900 c of Sr^{90} and would cost $84,600. It is designed for the study of continuous radiation-induced graft polymerization and β irradiation of small packages. (C.H.)

7811 A COMPACT COBALT-60 SOURCE FOR THE EXPERIMENTAL IRRADIATION OF FOOD SAMPLES. B. Coleby (Low Temperature Research Station, Cambridge, [Eng.]). Chem. & Ind., (London), 1375-8(Nov. 5, 1960).

The design and operation of a compact cobalt-60 source is described. Some of the desirable features of the source include: foodstuff samples of useful size, 7 to 8 cm in diameter, are exposed to a fairly uniform radiation field; the maximum dose rate is high; temperature and gaseous atmosphere of samples during irradiation is controllable; and easy access while inserting samples. The source and its pneumatic operating circuit are illustrated. (P.C.H.)

ISOTOPE SEPARATION

7812 (TID-14658) THE SEPARATION OF ISOTOPES AND ORTHO-PARA HYDROGEN AND DEUTERIUM BY PREFERENTIAL ADSORPTION AT LOW TEMPERATURE. THE THERMODYNAMIC PROPERTIES OF ORTHO-HYDROGEN AND PARA DEUTERIUM. Report No. 5. Technical Progress Report, December 1960–December 1961. David White (Ohio State Univ. Research Foundation, Columbus). Dec. 1961. Contract AT(11-1)-522. 62p.

Work is reported on heats of adsorption of hydrogen and deuterium on γ-alumina as a function of surface coverage, the effect of surface heterogeneity on isotope separations by preferential adsorption at low temperatures, ortho-para separation factors of hydrogen and deuterium from heterogeneous rates of conversion in the liquid state, heat capacity of solid deuterium at low temperatures, separation factors for the hydrogen isotopes by adsorption at low temperatures, rotational-vibrational zero point energies for the nine hydrogen species adsorbed on a surface, and separation of the nuclear spin species of methane by preferential adsorption. (M.C.G.)

7813 (AEC-tr-4983) GAS CENTRIFUGAL SEPARATION. Akira Kanagawa. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. from Genshiryoku Hatsuden, 4: Nos. 3-4, 49-61(1960). 55p.

The gas-centrifugal separation method as a uranium enrichment method is discussed from the standpoint of its historical development, theoretical and technical problems, and its economics as compared with the gas diffusion method. The possibilities and problems in the future development of this method are outlined. (M.C.G.)

7814 (AEC-tr-4984) HIGH-SPEED CENTRIFUGE FOR THE SEPARATION OF A GAS MIXTURE INTO TWO COMPONENTS IN A CONTINUOUS OPERATION. Jaap Wind and Johannes Los. Translated from German Patent 1,080,931. Apr. 28, 1960. 9p.

A high-speed centrifuge was developed for the separation of a mixture of gases into two components during continuous operation. It was provided with a tubular centrifugal drum rotatable around a vertical axis into which the ducts for the introduction of the gas mixture to be separated and for the discharge of the components terminate. The centrifugal drum rotates around its axis on a single point located beneath its lower end similar to a top. It is kept in the vertical position by means of a magnetic field in the direction of the axis. (M.C.G.)

7815 (AEC-tr-4985) SEPARATION OF BORON ISOTOPES. O. V. Uvarov, N. M. Sevryugova (Sevriugova), and N. M. Zhavoronkov (Zharorokov). Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. from Kernenergie, 3: 866-8(1960). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract No. 1739.

7816 (CEA-tr-X-282) METHODE DE FABRICATION D'HYDROGENE ET D'EAU LOURDE. (Method of Preparation of Hydrogen and Heavy Water). Jomar Brun. Translated into French from Norwegian Patent 77,177. [nd.]. 8p.

The method described for the preparation of hydrogen, heavy water, and metals or metal alloys is characterized by a combination of the following processes: (1) step electrolysis of water and formation of hydrogen containing deuterium, then concentration of heavy water in the electrolyte and (2) reduction of the metallic oxide with the deuterium-containing hydrogen from step 1. The metal is then oxidized by the water vapor at high temperature. These steps are repeated. The metallic oxide used is iron oxide. (J.S.R.)

7817 (CEA-tr-X-397) METHODES INDUSTRIELLES POUR L'ENRICHISSEMENT DE L'URANIUM-235. (Industrial Methods for Enrichment of Uranium-235). Istvan (E.) Kiss. Translated into French from Energia es Atomtech., 11: 466-73(1958). 32p. (Includes original, 8p.).

In the selection of an industrial method for the enrichment of U^{235}, the enrichment factor, the chemical and physical characteristics of the materials participating in the enrichment process, the engineering possibilities of the method, and the economics of the method must be considered. The gaseous diffusion process and the centrifugation process for heavy isotopic enrichment are discussed, and the enrichment factors are calculated theoretically. Cascade parameters and equilibrium times are calculated for the two processes. The energy requirements for a gaseous diffusion cascade and the engineering problems of such a plant are reviewed. (J.S.R.)

7818 DETERMINATION OF THE SEPARATION FACTOR OF LITHIUM ISOTOPES IN ION EXCHANGE. S. G. Katal'nikov, V. A. Revin, B. M. Andreev, and V. A. Minaev. Atomnaya Energ., 11: 528-32(Dec. 1961). (In Russian)

Previous studies of the separation of Li isotopes by ion-exchange methods considered primarily the structure of the cationite and the chemical nature of the salt used. The aim of this study is to determine the separation factor α of Li isotopes by subjecting LiOH and LiCl solutions of various concentrations to ion exchange reactions with native sulfocationite SBS and DU-2 and with Dowex-50. The particle size of the cationite used was kept between 0.25 and 0.50 mm. The value of α was determined by graphic methods in multistage experiments. Results indicated that in every case the Li^7 concentrated in the solution, the Li^6 on the cationite. The value of α was found to be dependent on the cationite used: excessive sulfonation of the cationite SBS affected greatly its separating ability. No differences were found between the α values obtained with either LiOH or LiCl in concentrations ranging from 1 to 5 N. The cationite with the lowest affinity toward Li yielded the highest α value. The dependence between K_{Li}^{H} and α is maintained even when Dowex-50 is used in which α depends on molal Li content of the exchanging cationite. (TTT)

7819 ON THE ISOTOPE SEPARATION BY COUNTER-CURRENT GAS CENTRIFUGE. II. RELATION BETWEEN FEED RATE AND SEPARATIVE POWER. Akira Kanagawa and Yoshitoshi Oyama (Tokyo Inst. of Tech.). Nippon Genshiryoku Gakkaishi, 3: 918-22(Dec. 1961). (In Japanese)

The separative power of a counter-current gas centrifuge was studied in relation to the gas circulation rate in the rotor and the gas flow rates into or out of the rotor. It was found that the separative power evaluated from a peak value of N_P/N_W, $(N_P/N_W)_P^C$, at a certain feed rate increases toward the maximum, as the feed rate increases and accordingly $(N_P/N_W)_P^C$ decreases. The circulation rate at which $(N_P/N_W)_P^C$ is obtained increases with the feed rate. The separative power rapidly approaches the saturated value, as the increase of the separation factor by the

longitudinal effect through the counter-current flow lowers. (auth)

7820 AN ANALYSIS OF GASEOUS DIFFUSION SEPARATING UNIT. Jun Oishi (Kyoto Univ.), Yoichi Matsumura, Kunio Higashi and Chieko Ike. Nippon Genshiryoku Gakkaishi, 3: 923-8(Dec. 1961). (In Japanese)

An analysis was made of two types of gaseous diffusion separating units. One type was such that the flows of unpermeated and permeated gas were rod-like and parallel with each other, and the other was such that the flows were counter-current. The analysis was a numerical calculation, and the characteristics of the separating unit, that is, gas composition, gas flow rate, separation factor, and separative power, were found. Discussions are given on the comparison of the characteristics of several types of separating unit, and it was concluded that the counter-flow type showed the best performance of separation. (auth)

7821 SEPARATION OF LITHIUM ISOTOPES BY BATCH OR CONTINUOUS ION EXCHANGE WITH DECALSO OR DOWEX-50 MEDIA. R. E. Blanco and J. T. Roberts (Oak Ridge National Lab., Tenn.). p.349-73 of "Technology, Engineering and Safety. Progress in Nuclear Energy. Series IV. Vol. 4." New York, Pergamon Press, 1961.

The lithium isotopic separation factors for the Dowex-50-X12 and Decalso-aqueous lithium chloride ion exchange systems were 1.0027 and 1.008, respectively. Effects on the separation factor attributable to concentration or the presence of complexing agents were within the limits of experimental error. The HTU for lithium ion exchange is low, a fraction of an inch in the absence of a complexing agent at a flow rate of 1 ml/min/cm^2, and approximately proportional to the flow rate. In the presence of an organic complexing agent, the HTU was larger and again was proportional to the flow rate. It was concluded that the efficiency of the system cannot be improved by increasing the throughput by means of faster flow rates. This fact and the low separation factor make it unlikely that lithium isotopes can be separated economically by ion exchange, even in a continuous contactor. (auth)

7822 ELECTROMAGNETIC SEPARATION OF RADIOISOTOPES OF THE HEAVY ELEMENTS AT THE OAK RIDGE NATIONAL LABORATORY. L. O. Love, G. M. Banic, W. A. Bell, and W. K. Prater (Oak Ridge National Lab., Tenn.). p.141-54 of "E.M. Separation of Radioactive Isotopes. Proceedings of the International Symposium, Vienna, May 1960." Vienna, Springer-Verlay, 1961. (In English)

Discussion is given on an ion source designed for use in plutonium separation, but which was sufficiently versatile to be used in uranium and stable isotope separation. Also discussed is a receiver concept which appears desirable in single isotope collections; included are typical results from the various separations programs. (P.C.H.)

7823 IMPROVEMENTS IN PROCESSES OF ISOTOPE-SEPARATION BY REFLUX ELECTROMIGRATION OF MOLTEN SALTS. Marius Chemla (Commissariat a l'Energie Atomique). British Patent 887,052. Jan. 17, 1962.

A process is given for the separation of isotopes by reflux electromigration of fused salts. The process is carried out in a countercurrent manner on a fused mixture of a salt containing the isotopic cations with a salt having the same anion as the first salt and a cation with a mobility as near as possible to that of the isotopic cations. Thus, possible precipitation of a eutectic mixture near the eutectic temperature due to unmixing of the salt is avoided. An electrolytic cell for carrying out the process is described, and an example of the use of the process is given in which Li^6 and Li^7 are separated in a LiBr–KBr mixture. (D.L.C.)

MATHEMATICS AND COMPUTERS

Refer also to abstract 8318

7824 (ACNP-6118) PATHFINDER ATOMIC POWER PLANT SUPERHEATER TEMPERATURE EVALUATION ROUTINE. AN IBM-704 COMPUTER PROGRAM. William B. Ross (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Oct. 31, 1961. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 49p.

A computer program was written for analysis of steam flow and heat transfer in fuel elements consisting of concentric fuel tubes with several annular coolant-flow channels. Performance of both average and hot-channel fuel elements may be evaluated since, for any heat generation rate, either total coolant flow rate or over-all pressure drop may be specified. The heat split from the fueled volume, thermal coupling between coolant channels, and heat loss from the fuel element are considered. Although any one run investigates only a single fuel element, any number of parallel fuel elements may be analyzed in successive runs by assuming that the pressure drop across the core is equal to the pressure drop across the nominal fuel element. Although written for inlet saturated steam at 615 psia, the program can be easily modified for use at any inlet condition. The program may be used on any 8K core IBM 704 computer. No tapes or drums are required. Typical running time for a problem composed of three flow channels, two fueled volumes, and four heat transfer surfaces, is approximately 2.5 min. (auth)

7825 (BNL-702) A TABLE OF THE BRILLOUIN FUNCTION. R. I. Schermer (Brookhaven National Lab., Upton, N. Y.). Dec. 1961. Contract [AT(30-2)-Gen-16]. 15p.

Tabulations are given of the Brillouin functions for integer and half-integer values from ½ through 5. (B.O.G.)

7826 (DC-57-5-173) 650 PROGRAM FOR CALCULATION OF THERMAL STRESSES IN THIN SPHERES. B. Kaplan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 7, 1957. Contract AT (11-1)-171. 26p.

Digital techniques are presented for computing with the IBM 650, thermal stresses in thin spherical shells subjected to an axially symmetric temperature distribution. The output of the program also consists of the related forces, moments, and displacements. (auth)

7827 (DC-58-2-166) PROGRAMMING INFORMATION FOR AN IBM SOLUTION TO THE GENERAL COLUMN BUCKLING PROBLEM. STRUCTURAL MEMO NO. 16. Sam W. Tagart (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 21, 1958. Contract AT(11-1)-171. 31p.

The theory behind an IBM solution to the column buckling problem where the column can have a variable flexural rigidity and elastic end restraints is described. This particular solution seems well adapted to IBM computation because it involves basically only three standard subroutines, matrix inversion, matrix multiplication, and matrix iteration. All of the information necessary to program this problem is presented. An analysis is included to justify the results. Two trial solutions were carried out using hand calculations and the results appear to agree quite well with known exact solutions. These two trial solutions are given. A sample data input sheet is also included in the results. (auth)

7828 (DC-58-4-212) SOLUTION OF A NON-AXISYMMETRIC SURFACE LOAD PROBLEM FOR A CIRCULAR CYLINDER USING FLUGGE'S EQUATIONS. Structural Memo No. 20. D. R. Riley (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 7, 1958. Contract AT(11-1)-171. 46p.

The analysis required for the solution of a non-axisymmetric surface load problem for a circular cylinder is presented and two methods of application of the solution to a practical problem are included. A discussion of the IBM 704 computer program for the solution of the problem is also presented along with 704 computer results for a specific configuration. Methods being incorporated for experimental verification of the 704 computer program are discussed. Computer input data in the form of configuration dimensions, loading conditions and physical constants yields an output of stress resultants, deflections and edge rotations in a grid over the cylinder. (auth)

7829 (DC-58-5-19) MONTE CARLO RESEARCH SERIES: FINITE CYLINDER GAMMA HEATING PROGRAM. A. H. Barnett and J. R. Beeler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 1, 1958. Contract AT(11-1)-171. 16p.

The IBM 704 program described computes the heat source density in a finite homogeneous cylinder due to photon energy degradation, given an arbitrary photon source in space and energy. The output is a gross radial and gross longitudinal histogram together with a listing of the heat source density in each of up to 400 disjoint volumes bounded by toroidal surfaces. (auth)

7830 (DC-58-5-47) SOLUTION OF THE FLEXURE PROBLEM OF THIN PLATES BY THE METHOD OF MUSKHELISHVILI. STRUCTURAL MEMO NO. 21. Howard A. Eagle (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 4, 1958. Contract AT(11-1)-171. 65p.

The Method of Muskhelishvili is used to solve the bending problem of thin plates in terms of two functions of a complex variable. Whereas the general method will handle plates of arbitrary planform whether they are simply connected, multiply connected, or infinite regions; only simply connected regions are considered. Both the lateral loading and the boundary conditions on the plate are arbitrary. Through the use of the two complex functions, the problem of either of the fundamental boundary value problems is reduced to the solution of a single complex boundary equation. A conformal mapping function, which maps the region occupied by the plate in the physical z-plane onto a unit circle in the ζ-plane, reduces the problem to the solution of the transformed boundary equation for a circular region of unit radius. A direct solution for this transformed boundary equation is obtained by a series solution. Two simple examples are solved in order to illustrate the method. (auth)

7831 (DP-664) IBM 650 ROUTINE VIII MULTIVARIABLE POLYNOMIAL REGRESSION. Richard R. Haefner (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1961. Contract AT(07-2)-1. 20p.

A routine was prepared for the IBM 650 to obtain a

least squares fit of a polynomial of as many as six independent variables to a set of experimental points for one dependent variable. The number of terms in the polynomial must be less than 35. The standard deviations in the unknown coefficient are also computed by the routine. A sample problem is included. (auth)

7832 (K-1497) A COMPUTER (7090) PROGRAM FOR OBTAINING THE PRODUCT OF CERTAIN DISCONTINUOUS FUNCTIONS. A. A. Brooks (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 16, 1962. Contract W-7405-eng-26. 8p.

An IBM 7090 computer subprogram was written to obtain the product of certain discontinuous functions which are represented in the machine as arrays of the abscissas of the discontinuities. (auth)

7833 (MURA-630) THE PARMESH DYNAMICS PROGRAM. Jess Anderson and George Parzen (Midwestern Universities Research Assn., Madison, Wis.). Dec. 6, 1961. Contract AT(11-1)-384. 9p.

The PARMESH dynamics program is discussed. The part of PARMESH which calculates the linear orbit properties such as the equilibrium orbit and betatron oscillation frequencies is presented. (auth)

7834 (NYO-9490) SOME COMPUTATIONAL METHODS FOR THE STUDY OF DIATOMIC MOLECULES. James W. Cooley (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). May 1, 1961. Contract AT(30-1)-1480. 155p.

A number of computational techniques are presented for the automatic machine calculation of the structure and properties of diatomic molecules. An automatic procedure is described which uses the Boolean operations of a binary computer for constructing N-electron pure state wave functions from a set of one-electron functions. Use of such automatic procedures permits one to calculate, by variational methods, electronic wave functions from a large number of electronic configurations and avoid the use and limitations of the self-consistent field procedure. The problem of minimizing a function of several variables was investigated and a search procedure which fits successive quadratic surfaces to calculated values was developed and programmed. The calculation of tables of molecular integrals of Slater-type orbitals, which have been published separately, is described. The numerical method for solving the radial Schroedinger equation for bound states is described and an improved eigenvalue correction formula is derived. An analysis of the procedure and some practical means for improving its convergence and accuracy are also given. The technique was programmed as a computer subroutine and used for obtaining nuclear wave functions and expectation values of properties of some diatomic molecules. An LCAO calculation of an electronic wave function for H_2^+, with a full optimization of the non-linear parameters by the minimization procedure mentioned above, was performed for the purpose of investigating the role of the orbital exponents and the applicability of the Virial Theorem, the Hellman-Feymann Theorem, and the static charge cloud model. The results lead to some suggestions which will be of use when applying similar methods to many-electron systems. The vibrational-rotational spectrum of H_2, HD, and D_2 was calculated with two electronic wave functions reported by other workers and excellent agreement with experiment was obtained. A number of molecular constants which are required in the interpretation of radiofrequency spectra are also given. (auth)

7835 (WAPD-TM-228) ZIP-2—A ONE-DIMENSIONAL FEW-GROUP SYNTHESIS NUCLEAR REACTOR DEPLETION PROGRAM FOR THE PHILCO-2000 COMPUTER. C. J. Pfeifer and F. R. Urbanus (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1961. Contract AT-11-1-GEN-14. 73p.

ZIP is a diffusion theory synthesis depletion program for reactor design calculations. The synthesis technique is a method of forming a solution to the three-dimensional, few-group diffusion theory equations, by "stacking" a number of different solutions to the two-dimensional (x,y) equations. The "stacking" is performed by deriving flux-weighted averaged quantities (diffusion constants, macroscopic cross-sections, and leakages) from the (x,y) solutions, for input to the ZIP program, which solves the one-dimensional (z) equations. (auth)

7836 SOME REMARKS ON THE BOLTZMANN AND ANTI-BOLTZMANN EQUATIONS. D. K. C. MacDonald (National Research Council, Ottawa). Phil. Mag. (8), 6: 1407-17(Nov. 1961).

Derivation of the familiar Boltzmann equation from the mechanical equations of motion of an isolated system is considered. Transition from over-all reversibility to irreversibility is discussed. The "anti-Boltzmann" equation appears paradoxical. It is suggested that a generalized Boltzmann–Langevin equation helps to resolve any paradox; either the Boltzmann–Langevin or anti-Boltzmann–Langevin equation may be used for prediction or retrodiction. The Boltzmann(–Langevin) equation remains the natural choice for prediction when apparently irreversible behavior is present. (auth)

7837 IMPROVEMENTS IN ANALOGUE DEVICES FOR DETERMINING THE PARTIAL DERIVATIVES OF A FUNCTION OF SEVERAL VARIABLES. Jean Borrel, Paul Braffort, Pierre Janot, and Jacques Pottier (to Commissariat a l'Energie Atomique). British Patent 886,019. Jan. 3, 1962.

An analog device for determining the partial derivatives of a function of at least two variables is designed which avoids the disadvantages of an electrolytic tank. The device comprises an electrical network with a plurality of nodes disposed along one direction and a voltage reader movable along a direction perpendicular to the first direction, and it is used in conjunction with a differential analyzer or computer for plotting the results. (D.L.C.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

7838 (AERE-M-518(Amended)) THE PREPARATION AND OXIDATION OF LARGE UO_2 CRYSTALS. M. H. Rand and E. E. Jackson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1959. 5p.

Crystals of UO_{2+x} of 10 mg weight and longest side ~3 mm were prepared by electrolysis of uranyl chloride dissolved in the LiCl–KCl eutectic at 450°C. These crystals can be oxidized and reduced over the range $UO_{2.0}$ to $UO_{2.25}$ without disintegration. By varying the experimental conditions, small single crystals of orthorhombic U_3O_{8-y} can be obtained. UO_2 crystals in the 1 to 50 μ range were sized by elutriation in water. (auth)

7839 (AGN-8044) RUBIDIUM AND CESIUM EVALUATION PROGRAM. Quarterly Technical Report (Report No. 3), August 1–October 31, 1961. Robert V. Arabian (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT(04-3)-368. 8p.

Progress is reported on the developments of a furnace and materials for obtaining corrosion and solubility data on containment materials for rubidium at 1000 to 2000°F. (B.O.G.)

7840 (BM-RI-5895) PRODUCING AND LADLE-TREATING MEDIUM-CARBON ALLOY STEELS WITH RARE-EARTH METALS AND OXIDES. R. J. Leary, E. J. Ostrowski, and N. Derick (Bureau of Mines, Bruceton, Penna.). Oct. 1959. 54p.

Significant improvements in surface conditions or mechanical properties of steels have been attributed by several investigators to ladle additions of small quantities of rare-earth metals or their oxides. To investigate systematically these effects in wrought and in cast plain carbon and alloy mechanical steels containing approximately 0.35% carbon, heats of four representative compositions were melted in a 4-ton open-hearth furnace. Each heat was cast into three sets of ingots to exemplify respectively, treatments with (1) rare-earth metals, (2) rare-earth metal oxides, and (3) an untreated set as a control. The development of melting, casting, and rolling practices is described. Lance injection of oxygen shortly after melt raised the temperature of the metal immediately as much as 500°F, principally because mechanical agitation exposed the high-carbon metal to the flame and furnace roof. An exceptional degree of superheat in the metal at the termination of the refining period was attributed to oxygen injection during the refining period. Bath temperatures higher than industrial practice were permitted by the all-basic furnace lining. Rates of carbon elimination as high as 0.036% carbon per minute were achieved by oxygen injections. Control of chemical composition was at least comparable to industrial experience, and recovery of alloying elements was higher. Recoveries of rare earths from rare-earth metals averaged 28% and were remarkably consistent. This level of recovery is considered relatively high in view of the high free energy of rare-earth oxide formation. Only a small fraction of the rare-earth oxide material was retained in the ingot product. The reason for a cerium to lanthanum (Ce : La) ratio of 3 : 1 in the ingot product against ratios of 1.5 : 1 in the rare-earth metal mixture and 2 : 1 in the oxide material is not known. Surface quality of 4-inch-square billets rolled from the ingots produced was judged to be representative of the base steel compositions. Billets from ingots treated with rare-earth metals had significantly fewer light seams but did contain myriad shallow, longitudinal discontinuities ranging from three sixteenths of one-half of an inch in length. These were not true seams. Although the surface of the billets was completely removed by grinding, this condition was again observed in the bars produced from these billets. Cross-sectional macroetch specimens from the billet product representing respectively the top and bottom of the product from each ingot were comparable in appearance to industrial experience with these grades. No difference was found between untreated specimens and those representing the rare-earth oxide treatment. However, steels that had been treated with rare-earth metals disclosed a characteristic pattern of irregularly-shaped voids adjacent to the periphery of the cross section. The investigators believed that these voids were related directly to the characteristic surface defects observed in the billets. (auth)

7841 (DC-59-10-153) PROTECTIVE COATINGS FOR LITHIUM HYDRIDE. F. H. Welch and J. C. Leslie (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 1, 1959. Contract AT(11-1)-171. 18p.

Fourteen organic coating materials for protecting lithium hydride from normal atmospheric water vapor were evaluated. Weight changes of unprotected and protected specimens are presented as a function of time of exposure. A hot dip coating of paraffin wax gave the best protection, although Vaseline, Lubriseal, and Mineral oil offered reasonably good protection. Tensile specimens of Type 301 (1/4 hard) stainless steel were heated in contact with lithium hydride and Lubriseal 100 hours at 800°F. A slight decrease in strength of the Type 301 was noted as a result of the treatment. (auth)

7842 (DC-59-10-174) SUMMARY REPORT ON INVESTIGATION OF EFFECT OF HEAT TREATMENTS ON WELDED R-235 ASSEMBLIES. M. A. Pugacz (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 22, 1959. Contract AT(11-1)-171. 23p.

Heat treating cycles for complex welded assemblies fabricated from R-235, a nickel base, aluminum-titanium precipitation hardening alloy for high strength, high temperature applications, were investigated. Results showed that cracking occurred consistently in the weld zone and in areas removed from the weld zone. An attempt to repair a crack resulting from a heat treating cycle, caused additional cracks to occur during the welding and a subsequent heat treatment. In view of these cracking tendencies, R-235 is not recommended for use as a material of construction for complex parts where reliability is to be a factor. Furthermore, R-235 and other age hardening alloys of this type are not recommended for applications which approach solutioning temperatures or which may cycle between the aging and solutioning temperatures. (auth)

7843 (DC-60-8-94) STRESSES IN STACKED CYLINDER MATRICES. D. H. Webber (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 17, 1960. Contract AT(11-1)-171. 34p.

A porous media consisting of stacked cylinder matrices is treated for stress due to mechanical and thermal loading. A survey of the factors involved, the derivation of a convenient parameter for design use, and examples of stress calculation are given. (auth)

7844 (DC-60-8-736) EVALUATION OF FIBERGLASS AND FIBERFRAX AS FILTER MEDIA FOR ETR APPLICATION. R. C. Moreland (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 30, 1960. Contract AT(11-1)-171. 8p.

The results of tests conducted on various grades of Fiberglass and Fiberfrax filter material to determine their resistance to deterioration under conditions to which they will be subjected during processing, assembly, and operation in an effluent filter assembly at the ETR are reported. A number of photomicrographs of two grades of Fiberfrax filter fibers in various stages of processing and pressure drop data on the two grades of Fiberfrax material are included. (auth)

7845 (DC-60-10-17) SOLID STATE PHYSICS SERIES: THE DYNAMIC THEORY OF CRACK PROPAGATION. J. R. Beeler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 1960. Contract AT(11-1)-171. 13p.

Four basic articles on the theory of brittle and semi-brittle cracks are summarized. Emphasis is placed upon the recently developed theory of dynamic criteria for crack propagation. A relationship between the existence of a critical propagation velocity and transient effusion behavior of fission product effusion during temperature changes is postulated. (auth)

7846 (DLC-58-12-17) PREPARATION OF BERYLLIUM OXIDE. R. Cooperstein (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 26, 1958. Contract AT(11-1)-171. 10p.

A procedure for producing high-purity BeO is described. (J.R.D.)

7847 (NAA-SR-6425) BERYLLIUM OXIDE SINGLE CRYSTAL GROWTH. [PART] I. ALKALI MOLYBDATA METHOD. S. B. Austerman and A. R. Hopkins (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 15, 1962. Contract AT(11-1)-GEN-8. 40p.

The growth of beryllium oxide in alkali molybdates, principally $Li_2MoO_4-MoO_3$, resulted in the production of crystals up to five millimeters (imperfect) and two millimeters (clear, well-formed) in size. Although several techniques were employed, a slow cooling rate of 25 to 1.5°C/hr, starting at 1400°C, was found most suitable. The crystals commonly developed some modification of the pyramidal habit as a growth form, but under equilibrium conditions prismatic crystals were produced. Details of other growth features are described. The mechanisms of growth in terms of current theories of crystal growth are discussed. The experimental results generally appear to be consistent with the theories. The general behavior of the alkali molybdate-beryllium oxide system and the character of the produced crystals are described. However, much study remains to be done to fully understand all the details of growth and to control the causes for imperfection in crystals grown from alkali molybdates. (auth)

7848 (VDIT-47) THE DIFFUSION OF CHROMIUM AND CARBON IN FERRITIC IRON AND CERTAIN IRON ALLOYS. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Nov. 1961. 4p.

An annotated bibliography is presented consisting of 14 references to studies of the diffusion of chromium and carbon in ferritic iron and certain iron alloys. The time of publication of the references ranges from 1949 to 1960. Sources of information used for the compilation include Nuclear Science Abstracts, Metallurgical Abstracts, Review of Metal Literature, and the Ab Atomenergi card index of current publications. (B.O.G.)

7849 THE REFINING AND PHYSICAL PROPERTIES OF LEAD. J. Neill Greenwood (Univ. of Melbourne). Met. Revs., 6: 279-315(1961).

The methods used in refining lead are described and the properties of lead and its alloys are presented. The information obtained is supported by 235 listed references. (N.W.R.)

7850 REMOTE MOUNTING OF SPECIMENS. W. H. Leith (E. I. du Pont de Nemours & Co., Carney's Point, N. J.). Metal Progr., 81: 111-12(Feb. 1962).

A new adhesive, Eastman 910, is used for remote mounting of irradiated metallographic specimens in a manner that will not interfere with subsequent cathodic etching. The specimen is glued to a metal mount for grinding and polishing, and is easily removed when it is to be etched. (auth)

7851 GAS CONTENT OF GRAPHITES. [PART] I. Seishi Yajima, Sumio Ichiba, and Muneo Hanada (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 3: 942-8(Dec. 1961). (In Japanese)

Gas evolution from graphite was studied. The materials used for the study included natural and artificial graphites and amorphous carbon. All the materials were received in the form of powder. Degassing was carried out at 300, 600, and 1,000°C in vacuo. The total volume of gases evolved ranged from 410 to 7,190 μl/g of graphite. Oxygen, nitrogen, and hydrogen were mainly evolved when degassed at 300°C, and various hydrocarbons (up to 50% of the total volume) evolved when degassed at 600°C. When degassed at 1000°C, carbon monoxide and hydrogen were predominant among all gases evolved. An analysis of the gases was carried out entirely by gas chromatography. A Molecular Sieve-5A column was used for the inert gas analysis and a two stage column, dioctyl phthalate-A and dimethyl sulforane, for the analysis of hydrocarbons. The total volume and the ratios of the gases evolved from the graphites at experimental temperatures are discussed in detail and the states of existence of the gases in graphite are also discussed. (auth)

7852 LAMINATED MATERIAL HAVING HIGH THERMAL ISOLATING PROPERTIES. Lucien Alfille (to Commissariat a l'Energie Atomique). British Patent 887,345. Jan. 17, 1962.

A flexible heat-insulating material is described which retains both its insulating capacity and flexibility at high temperatures. The material comprises an assembly of separate superposed metallic layers not exceeding 0.2 mm in thickness, each layer having on its faces a compact, adherent film of metal oxide. The material is especially suited for being wound helically as flexible strips. In one preferred form of the invention, the material is aluminum oxidized by the anode process on both sides. (D.L.C.)

Corrosion

7853 (EURAEC-151) RESULTS OF CORROSION AND EROSION EXPERIMENTS WITH STEAM-WATER SPRAY. Special Report No. 8. A. Bassi, E. Brutto, G. Imarisio, G. Palladino, G. Perona, and R. Sesini (Centro Informazioni Studi Esperienze, Milan). July 1961. Work Performed under United States-Euratom Joint Research and Development Program. Contract 002-59-11RDI. 99p. (CISE-R-40)

Experimental data on dynamic corrosion of Zircaloy-2 and stainless steel in steam-water mixtures are reported. The measurements were performed at 245 to 287°C using vertical straight and curved round tubes with a total specific mass flow-rate of from 266 to 553 g/cm^2 sec and a steam quality of from 0.3 to 0.63. The comparison of dynamic corrosion tests in flowing wet-steam, with static corrosion tests in autoclave seemed to indicate an influence of the specific mass flow-rate on the corrosion rate. The corrosion rate in flowing wet steam appeared always higher than in static water. Curves are given for weight gain versus time and weight gain versus temperature. No erosion was observed up to the maximum specific mass flow-rate attained, except in stainless steel curved tubes. (auth)

7854 SHOT PEENING OF METALS FOR PROTECTION AGAINST STRESS CORROSION CRACKING. Henry Suss (Knolls Atomic Power Lab., Schenectady, N. Y.). Corrosion, 18: 17t-20t(Jan. 1962).

Shot peening, when properly incorporated into a specific product design and effected by a properly designed and controlled process, will protect hardened (RC36-42) AISI 410 stainless steel from stress corrosion failure in high purity waters. This protection occurs at temperatures up to 300°F for a useful finite period at stresses up to 60000 psi, and indefinitely at stresses up to approximately 45000 psi, about one-third of the yield strength. Before shot peening is used for protection against stress corrosion attack, consideration must be given to the effects of the environment, anticipated stresses, and temperature of application on the fadeout of the surface residual layer. For most applications there should not be any problem in establishing adequate process and quality control procedures. The basic data developed on shot peening of AISI 410 could be made applicable to other susceptible alloys as means for protection against stress corrosion attack. (auth)

7855 CORROSION OF INCONEL NICKEL–CHROMIUM ALLOY IN PRIMARY COOLANTS OF PRESSURIZED WATER REACTORS. H. R. Copson (International Nickel Co., Inc., Bayonne, N. J.) and W. E. Berry. Corrosion, 18: 21t-6t(Jan. 1962).

A study was made of the corrosion resistance of Inconel nickel–chromium alloy for applications in the primary coolant circuit of pressurized-water reactors. Tests were conducted in lithium hydroxide treated water (pH 10) under simulated static control-rod environmental conditions at 300°F, in the same water under bulk-coolant flow conditions at 550°F, and in static ammoniated water (pH 9.5) at 550°F. Inconel alloy was coupled to itself and to a number of stainless steels, nickel-base alloys, and other materials. The corrosion behavior of Inconel alloy weld overlays on mild steel also was investigated. The results of 2000-hour tests have shown no acceleration of attack on any of the dissimilar metal alloys in the galvanic couples. Different heat treatments, cold reduction, or variation in alloy composition had no adverse effect on the excellent resistance of Inconel alloy. The weld metal overlays also proved to be satisfactorily resistant to the primary coolant waters in these tests. (auth)

7856 TESTING STEAM GENERATOR MATERIALS FOR PRESSURIZED WATER REACTOR PLANTS. John W. McGrew (Martin Co., Baltimore). Corrosion, 18: 27t-32t (Jan. 1962).

Selected materials for use in nuclear power plant steam generators were evaluated in a simulated nuclear system. Low carbon steel, Croloy 16-1, and Inconel were compared to AISI Type 304 in their resistance to general corrosion, pitting, and stress corrosion cracking. The secondary environments were unusually severe, so that differences among the metals tested would be apparent within a reasonable test time. Simultaneously, overall performance would serve to indicate the difficulties that might be encountered in attempting to operate a field reactor with little or no treatment of the secondary water. The AISI Type 304 superheater cracked severely from chloride stress corrosion and the test was discontinued after 1927 hours. A bimetal steam generator and superheater with the AISI 1020 carbon steel side of the tubes in contact with the secondary environment were service tested 5041 hours without failure. A steam generator and superheater with Croloy 16-1 tubes and a steam generator and superheater with Inconel tubes were service tested 4253 and 3819 hours respectively without failure. The Inconel vessels were superior to all of the others in the test environments used. (auth)

7857 CAUSES OF A SECOND TRANSITION POINT OCCURRING DURING OXIDATION OF ZIRCONIUM ALLOYS. B. Cox (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Corrosion, 18: 33t-6t(Jan. 1962).

Tests were conducted in 500°C steam to determine the cause of a second transition point observed to occur during the oxidation of zirconium alloys. While oxygen penetration into the samples was not entirely discounted as a possible cause for the second increase in the oxidation rate, tests pointed strongly to hydrogen accumulation as being largely responsible for this change. It was found that this second transition occurred only in those alloys which showed severe absorption of hydrogen during corrosion in steam. Tests indicated that increases of up to a factor of four on the initial post-breakaway rate came about at high hydrogen concentrations. Comparison with oxygen diffusion data showed that this latter phenomenon did not occur fast enough to account for the change in kinetics observed. (auth)

7858 EFFECT OF PARTIAL DISSOLUTION OF THE OXIDE FILM ON THE AQUEOUS CORROSION RESISTANCE OF ZIRCALOY-2. S. Kass and D. B. Scott (Westinghouse Electric Corp., Pittsburgh). J. Electrochem. Soc., 109: 92-4(Feb. 1962). (WAPD-T-1078)

The aqueous corrosion resistance of corrosion-tested Zircaloy-2 was found to decrease markedly after vacuum heating to dissolve the oxide film partially. Although a complete explanation of the accelerated corrosion is not proposed, several possible mechanisms are presented. (auth)

7859 PRECIPITATION-HARDENING STAINLESS STEELS IN WATER-COOLED REACTORS. M. C. Rowland and W. R. Smith, Sr. (General Electric Co., San Jose, Calif.). Nuclear Eng., 7: 14-22(Jan. 1962).

A study is made of the stress corrosion susceptibility of unirradiated precipitation-hardening stainless steels. This study is made because of the failures encountered with these materials in the Dresden and Vallecitos boiling water reactors. Service experience, static steam autoclave tests, and dynamic water and steam corrosion loop tests have demonstrated that 17-4 PH in the high-hardened, H900 condition is subject to stress corrosion cracking even at relatively low applied stresses in high purity water at temperatures ranging from 200 to 550°F. The test results indicate, however, that in the H1100 condition, 17-4 PH is resistant to stress corrosion cracking at stresses up to the yield point; and that only at very high stresses approaching 1% strain does there appear to be any danger of stress corrosion cracking. The number of tests on the

other materials do not support firm conclusions, but it is evident that 17-7 PH (1050), A-286 (1325), and AM-350 (850 and 1000) are all less susceptible to stress corrosion cracking in high-purity water than 17-4 PH (H900). No failures of any of the steels, except 17-4 PH (H900), have occurred at applied stresses up to the yield strength. Only very high stresses over yield have produced any cracking in the limited tests performed. (N.W.R.)

Fabrication

7860 (ATL-A-125) INVESTIGATION OF THE TECHNICAL FEASIBILITY OF COLD EXTRUSION FOR ZIRCALOY-2 TUBING PRODUCTION. Quarterly Technical Progress Report, July–September, 1961. F. E. Weil and J. G. Hill (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Contract AT(04-3)-250. 8p.

Bar-extrusion tests were performed at 50, 65, and 80% reductions at room temperature and 300°C. Tensile tests were conducted on as-extruded and heat-treated specimens. The results are tabulated for comparison. The extrusion of small tubing, 0.560-in. OD × 0.030-in. wall, in the first and second tube-extrusion steps are described. (B.O.G.)

7861 (DLC-57-7-37) FABRICATION OF CLAD MODERATOR COMPONENTS BY AMR. J. A. McGurty (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 8, 1957. Contract AT(11-1)-171. 9p.

Developmental work on fabrication processes for clad hydrided Zr moderator are described. One process involves expansion of Ti alloy rods inserted in moderator and hydrided. Such expansion brings inside cladding into contact with the hydrided Zr and expands the hydride into contact with the external cladding. A second process involves use of inert gas for exerting required pressure at the cladding interfaces. Another process is a dip braze in which argon is used to force liquid braze alloy into an evacuated element along the interfaces. (J.R.D.)

7862 (DCL-58-2-39) DEVELOPMENT OF EDGE SEALING BY THE SEAM WELDING METHOD. F. E. McBride and J. A. Van Velzor (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 10, 1958. Contract AT(11-1)-171. 18p.

A portion of the program to develop a procedure for resistance seam welding edge seals on fuel ribbon is described. The scope of the program, a description of methods evaluated, a discussion of the experimental procedure, and the results of test program are included. A basic procedure for edge sealing Nb fuel ribbon is also included. (auth)

7863 (MAB-179-M) REPORT OF THE SUBPANEL ON CONSOLIDATION AND FABRICATION. REFRACTORY METALS SHEET ROLLING PANEL. (National Research Council. Materials Advisory Board). Dec. 1, 1961. 27p.

A survey is presented of the meetings of the subpanel for discussions on the consolidation, hot working, and warm-cold finishing of refractory metal sheet and the production of refractory metal seamless tubing. Recommendations are given which may lead to significant improvements in the quality, recovery, and cost of refractory metal sheet. (B.O.G.)

7864 (NMI-1245) HOT EXTRUSION OF UO_2 FUEL ELEMENTS. FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Final Report for the Period July 1, 1960 through June 30, 1961. J. G. Hunt, D. F. Kaufman, and P. Loewenstein (Nuclear Metals, Inc., Concord, Mass.). Oct. 31, 1961. Contract AT(30-1)-1565. 49p.

A hot extrusion technique for stainless steel-clad UO_2 fuel elements was developed that demonstrates that UO_2 can be extruded in a manner analogous to metals. The process, based on the multi-temperature coextrusion technique previously used for metallic fuel elements, involves the coextrusion of UO_2 at 1875°C within the cladding at 760°C. The principles employed, the experiments for process development, process and product description, and fabrication of enriched irradiation specimens are discussed. (auth)

7865 (NMI-7204) EVALUATION OF ZIRCALOY-4-CLAD U–1 w/o Si TUBE NO. 79. W. J. Richmond (Nuclear Metals, Inc., Concord, Mass.). Nov. 20, 1961. Contract AT(30-1)-1565. 27p.

An evaluation is presented of a tube, with a slightly enriched (3%) U–1 wt.% Si core, which was fabricated to provide irradiation test material. The data show that the tube meets irradiation specifications in all characteristics. (B.O.G.)

7866 (NP-11184) DEVELOPMENT OF TECHNIQUES FOR PRODUCING BERYLLIUM STRUCTURAL SHAPES. Fourth Interim Technical Report, May 19, 1961–November 13, 1961. Final Phase III Report. E. E. Weismantel and K. C. Taber (Beryllium Corp., Reading, Penna.). Contract AF33(600)-41959. 66p.

The Phase III effort has extended the processing information obtained in Phase II to allow the attainment of the desired structural shapes through several alternative processes. The round and square solid shapes have been proven readily producible through simple roll reduction of previously extruded shapes. Angles, channels, and zees can be formed through the bending of sheet metal of the desired thickness to the desired geometry. This program has demonstrated that for forming at 1350 to 1400°F, 0.060-inch thick sheet required a 3T to 4T internal forming radius if roll forming was used whereas a 7T radius was necessary for mechanical press-brake forming. For 0.188-inch thick sheet a radius of 3T to 4T was required for roll forming, and mechanical press-brake forming required a $4\frac{1}{2}$T radius for satisfactory bends in this temperature range. A composite billet process was developed for the production of tee-shaped sections that were not producible by the methods used for the other shapes. In comparing the advantages of this process with the other production paths studied, it was decided that all Phase IV shapes would be produced by this method. Considerable potential exists in this method for the production of increasingly complex shapes to higher strength levels than those originally specified for the program. Introductory experiments have demonstrated the ability to achieve over 100,000 psi ultimate tensile strength and 70,000 psi tensile yield strength with 5% elongation in using this approach. (auth)

7867 (NYO-10005) APPLICATION OF ULTRASONIC VIBRATION TO COLD PRESSING OF CERAMIC PELLETS. William B. Tarpley and Herbert Kartluke (Aeroprojects, Inc., West Chester, Penna.). Nov. 1961. Contract AT(30-1)-1836. 17p.

Difficulties in the preparation of generally spherical-shaped pellets for nuclear reactor fuel or blanket beds have involved inadequate density and residual stresses leading to low mechanical properties. Equatorial cracking, capping, and poor die release have been eliminated for several alumina compositions by ultrasonic activation of the upper hemispherical punch. Cold forming under these conditions resulted in a 100% yield of intact pellets in comparison to 0 to 10% for the nonultrasonic controls;

an increase in green density of more than 50% was achieved. Conceptual adaptations to incorporate ultrasonic activation in production pressing equipment are described. (auth)

7868 (NYO-10008) ULTRASONIC TUBE DRAWING: NIOBIUM, ZIRCALOY-2, AND COPPER. William B. Tarpley and Herbert Kartluke (Aeroprojects, Inc., West Chester, Penna.). Dec. 1961. Contract AT(30-1)-1836. 25p.

Ultrasonic activation of screwed-insert hardened tool steel or carbide dies resulted in reduced drawing forces and in increased rates when applied to copper, Zircaloy-2, or niobium tubing. Reductions in metal area from 13 to 57%, and drawing rates up to 225 ft/min were studied with tubing in the 1/4-in. size range. Drawing rate increases up to 13 fold for copper and 100 fold for Zircaloy-2 were observed. At a constant rate of 15 in./min a force reduction of 40 to 80% was attained with copper, and 15% with niobium. It was also observed that tubing which could not be started under a given set of conditions would draw with ultrasonic activation. The observed ultrasonic effects cover a range from easy to difficult materials. (auth)

7869 (PLASTEC-6) STATE OF THE ART: METHODS OF BONDING FLUOROCARBON PLASTICS TO STRUCTURAL MATERIALS. Marjorie C. St. Cyr (Picatinny Arsenal. Plastics Technical Evaluation Center, Dover, N. J.). May 1961. 27p. (PB-171037)

Plastics of the fluorocarbon group were explored for their possible use in constructions which utilize adhesive bonding. The properties and methods of bonding of various materials derived from five basic fluorocarbons are summarized. The literature provided information within four general areas. These are presented under the following main headings: fluorocarbon plastics, availability and properties; methods for bonding sintered fluorocarbons; methods for bonding melt-processible fluorocarbons; and miscellaneous specialty products. The technology basic to the identification and description of the various plastics is briefly given. Commercial suppliers are identified. Included are instances illustrating the practical applications of the techniques. A bibliography of publications on this subject is included. (auth)

7870 DEPOSITION OF PYROLITIC CARBON FROM METHANE IN THE PORES OF ARTIFICAL GRAPHITES. INFLUENCE OF THE TEMPERATURE. René Blanchard, Louis Bochirol, Claude Moreau, and Joseph Philippot (Centre d'Etudes Nucleaires, Grenoble, France). Compt. rend., 252: 3989-91(June 19, 1961). (CEA-2019). (In French)

It is shown that below 1000°C the carbon formed by the decomposition of methane is deposited at a depth of up to several centimetres in the pores of graphitic supports; the probable mechanism of the reaction is given. (auth)

7871 CLEAN CONDITIONS DURING GRAPHITE MACHINING AND STORAGE. B. J. Goulding (Atomic Power Construction Ltd., London). Nuclear Eng., 7: 29-30(Jan. 1962).

The strict cleaning conditions necessary during graphite manufacture and storage for use as reactor component materials are described. Particular attention is given to the type of graphite used, the equipment used, the room used for manufacture, the change room, and inspection and storage areas. (N.W.R.)

7872 DEPOSITION OF $^{95}Zr(+^{95}Nb)$ AND ^{60}Co ON VARIOUS METALLIC AND NON-METALLIC SURFACES. Elwira Herczyńska (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 659-65 (1961). (In English)

The deposition of $Zr^{95}(+Nb^{95})$ and Co^{60} on surfaces of Pt, Al, Sn, Cu, perspex, and glass is studied as a function of solution pH. Observed deposition behavior confirms the ion-exchange mechanism of deposition. (auth)

7873 IMPROVEMENTS RELATING TO THE FORMATION OF FINS ON METAL BAR OR TUBE STOCK. Alan Vines and George Thomas Maughan (to Fairey Co., Ltd.). British Patent 886,017. Jan. 3, 1962.

A method and an apparatus are described for forming integral external fins on metal bar or tube stock by outward extrusion. In this method, one or a pair of rapidly vibrating former tools with open-ended grooves is pressed into the side of the workpiece, and the workpiece is advanced along its length to form the fin progressively in the groove. The workpiece is heated to a temperature sufficient to plasticize the material prior to fin formation. (D.L.C.)

Properties and Structure

7874 (ANL-6375) THE EFFECT OF ADDITIVES ON THE DENSIFICATION OF URANIA-THORIA COMPOSITIONS. Final Report—Metallurgy Program 9.2.2. George D. White (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-Eng-38. 19p.

An investigation is reported of the effect of several oxide additives on the densification of UO_2-ThO_2 compositions in which U_3O_8 is the initial uranium oxide. Also determined were the effects on densification of variation of the compaction pressure and of the pretreatment of the oxide powders. The validity of results was checked by two forming techniques, dry pressing and extrusion. The results are indicated as follows: additives had an increasing effect on densification with decreasing ThO_2 content; oxides of transition elements were most effective as additives for improving the densification; varying the forming pressure had little effect on densification; precalcination of the initial powders was effective in improving densification; and similar results as above can be achieved with extruded as well as dry-pressed specimens. (auth)

7875 (ARF-2230-3) DELAYED FAILURE HYDROGEN EMBRITTLEMENT OF ZIRCONIUM. Quarterly Report No. 1, September 15, 1961 to December 14, 1961. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 3, 1962. Contract AT(11-1)-578. 15p.

A research program to determine the extent to which Zr and Zircaloy-2 exhibits delayed failure (static fatigue) as caused by absorbed H_2 and applied stress is outlined. Dynamic tensile tests were carried out on Zr and Zircaloy-2 without and with 200 ppm H_2. Preliminary results of a delayed failure investigation suggest that Zr containing 200 ppm H_2 is relatively insensitive to delayed failure at room temperature up to 900 hr. (D.L.C.)

7876 (DC-57-5-107) PREDICTION OF HYDROGEN MIGRATION IN ZIRCONIUM HYDRIDE. R. E. Motsinger (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 10, 1957. Contract AT(11-1)-171. 20p.

A method for predicting H migration and the rate at which it proceeds is given for hydrided Zr. The method uses the equilibrium solubility of H in Zr which by itself determines limiting amounts of migration. Also, when reliable diffusion coefficients are determined, the rate at which the process occurs can be dependably predicted. H loss rates from unclad Zr are used to evaluate the diffusion coefficient, which when used in the analysis, give excellent correlation with test results. However, the reliability uncertainty in the loss rates as now quoted in ANPD data, makes it appear that the

prediction of the rate of migration was fortuitous. The method, however, appears to be substantially confirmed by the success of the correlation. (auth)

7877 (DC-58-2-215) DIFFUSION COEFFICIENT CALCULATIONS WITH AN APPLICATION TO THE DIFFUSION OF ALUMINUM. Anthony Trampus (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 1958. Contract AT(11-1)-171. 9p.

The calculation of diffusion coefficients for two-phase systems is described. An application of the calculation results is made to the study of Al diffusion in a Nb-UO_2 core clad by Fe-Cr-Al. (auth)

7878 (DC-58-6-152) THE EFFECT OF STRESS RELIEF AND HEAT TREATMENT UPON ROOM TEMPERATURE PROPERTIES OF INCONEL "X". G. L. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 16, 1958. Contract AT(11-1)-171. 23p.

To determine the effect of stress relief, such as required during the fabrication of complex structures, upon the room temperature properties of Inconel X, parent metal and welded tensile specimens were stress relieved 1, 2, 5, and 9 times before aging. Conclusions are that stress relief of Inconel X does not affect the properties of the material, but in all cases Inconel X should be annealed or solution treated after stress relief and before aging. (auth)

7879 (DC-58-7-146) STRESS-STRAIN-TEMPERATURE-TIME RELATIONSHIPS IN REFRACTORY MATERIALS. R. D. Chipman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 23, 1958. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Contract AT(11-1)-171. 40p.

Various aspects of a program for obtaining creep data for refractories are discussed. A bending test facility built around an existing furnace is described. Of particular significance is a continuous recording deflection measurement system. Testing procedures and their influence on data are discussed briefly. Modulus of rupture and relatively short time creep data for some high density, high purity BeO and SiC bodies are presented. Tests were conducted from room temperature to 2730°F. Testing time varied from a fraction of a minute to 24 hours. Stress-strain-temperature-time relationships represented by test data are evaluated semi-quantitatively. Limitations of the methods employed and plans for future work are discussed. (auth)

7880 (DC-58-11-13) ANALYSIS OF BARE SLOTTED MODERATOR (PROJECT 102, NO. SYN007X3-Ti). A. J. Alexander (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 30, 1958. Contract AT(11-1)-171. 12p.

A dynamic test was carried out on a bare hydrided zirconium moderator in the shape of a hexagonal tube with internal cooling slots. Thermal cycling was performed between 300 and 1150°F. Hydrogen migration was observed in the radial direction, and total hydrogen loss was ~4%. Circumferential cracks were found on the inside of the tube in the 1090°F region. (D.L.C.)

7881 (DC-59-1-242) CHARACTERISTICS OF INCONEL-X SPRINGS UNDER CONSTANT LOAD AND CONSTANT SPRING HEIGHT CONDITIONS AT 900°. Thermodynamics and Mechanics Development Report No. 451. M. A. Koenders (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 30, 1958. Contract AT(11-1)-171. 22p.

Two Inconel-X springs as specified for the 103A core were tested in compression under static load conditions. Data are reported on spring constants at 80, 800, and 900°F, and permanent deformation values, as a function of time at 900°F, tested for 119 hours under a constant load of 180 pounds (68,900 psi torsional stress or 0.916 inch deflection). Load capacity loss (initial load 203 pounds or 77,610 psi torsional stress) encountered with the spring tested for 96 hours at 900°F under a constant spring height of 3.519 inches (initial deflection of 1.062) was also determined. (auth)

7882 (DC-59-3-188) BERYLLIUM RESEARCH IN THE USSR. Information Bibliography. J. H. Guill and J. Woroncow, comps. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 19, 1959. Contract AT(11-1)-171. 30p.

The bibliography contains about 215 references. The organization with which the author is associated is listed if known. (J.R.D.)

7883 (DC-59-9-53) INVESTIGATION OF TWO INTERMETALLIC COMPOUNDS IN THE RHENIUM–BERYLLIUM SYSTEM–$ReBe_{18}$ AND $ReBe_2$. G. C. Huth and J. P. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 25, 1959. Contract AT(11-1)-171. 8p.

Two intermetallic compounds of the Re-Be binary system–$ReBe_{18}$ and $ReBe_2$–were prepared in essentially single phase form, fabricated into billets by hot pressing in vacuum, and evaluated as to their oxidation resistance. $ReBe_{18}$ (density 3.8 grams/cm^3) shows promise for use at temperatures greater than 2000°F. $ReBe_2$ (density 11.5 grams/cm^3) oxidized completely at these temperatures. (auth)

7884 (DC-60-7-64) PHYSICAL PROPERTIES OF WARM ROLLED FUEL SHEET. P. M. Loomis (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 13, 1960. Contract AT(11-1)-171. 26p.

The original data and curves for the elevated temperature short time tensile tests, the creep tests, and the thermal elongation tests which were run on warm rolled nichrome fuel sheet are given. The test specimens were made from 0.025 thick, 0.004 clad thickness, depleted, 42% core material. (auth)

7885 (GAMD-2476) PROCESSING OF GRAPHITE SPECIMENS FOR HIGH TEMPERATURE IRRADIATION BY HANFORD. G. B. Engle (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 9, 1961. Contract AT(04-3)-314. 9p.

A study was made of the effects of heat treatments to 2900 and 2925°C and impregnations on the electric conductivity of HLM-85 and NCC-core graphite specimens. The results are graphed and tabulated. The effects of carbon pickup on the electric conductivity of impregnated samples are shown graphically. (B.O.G.)

7886 (HW-70859) TRANSFORMATION KINETICS OF PLUTONIUM. PART III. R. D. Nelson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1961. Contract AT(45-1)-1350. 56p.

Isothermal reaction curves and T-T-T curves showing the effect of different variables on the beta–alpha transformations in plutonium are presented. Impurity content, stresses, beta heat-treating time and temperature, hydrostatic pressing, specimen size, and thermal cycling influenced the kinetics of the beta–alpha transformation. Decreasing the impurity content increased the rate of transformation. High tensile stress retarded the beta–alpha transformation. Increasing the beta heat–treating

time and temperature markedly decreased the rate of transformation. Hydrostatic pressing at 90,000 psi accelerated the beta–alpha transformation under pressure but decreased any subsequent beta–alpha transformations by as much as two orders of magnitude. Specimen size had no effect on the start of the transformation but increasing the specimen size from 0.010 to 0.37 inch decreased the rate of completion of transformation several orders of magnitude. Thermal cycling less than 15 cycles did not affect the rate of transformation. The density of high purity plutonium during hydrostatic pressing at 180°C and cooling under pressure increased from 19.60 to 19.65 g/cm^3 to 19.70 to 19.75 g/cm^3. This increase was shown to be attributed to decreasing the volume of microcracks rather than transformation of any metastable beta phase. A T-T-T curve of the alpha–beta transformation is given which shows the start of the transformation is 16 hours at 116.5°C with the rate decreasing extremely rapidly with decreasing temperature. The times for the start and completion of the transformation were significantly shorter than the early work reported. The faster rate was attributed to less impurities. The gamma–beta–alpha and alpha–beta–gamma transformations are discussed also. Isothermal reaction curves and T-T-T curves for these transformation are included. (auth)

7887 (NP-11168) THE EFFECT OF URANIUM ON TEMPER EMBRITTLEMENT. R. F. Knight and W. A. Morgan (Canada. Dept. of Mines and Technical Surveys. Mines Branch). May 23, 1961. 10p. (CURF-R-9; PM-R-61-11)

It is shown that at the levels of uranium content investigated, additions of uranium increase temper embrittlement in AISI 3310 steel. A maximum in the effect seems to occur at a total uranium content of about 0.03%. The grade of steel investigated exhibited an enormous tendency toward temper embrittlement. An addition of molybdenum reduced but did not eliminate the embrittlement. (auth)

7888 (NP-11196) PROCEEDINGS OF THE CONFERENCE–SYMPOSIUM ON MATERIALS RESEARCH IN CANADA HELD AT THE UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, B. C., 6, 7 AND 8 JUNE , 1960. (Canada. Defence Research Board and British Columbia. Univ., Vancouver). June 1961. 115p. (R/AE4)

The proceedings on materials research in Canada present reports of government and university research in the materials field. Twenty-five papers are included. Separate abstracts were prepared for 5 papers. (M.C.G.)

7889 (NP-11196(p.16-20)) RESEARCH AND DEVELOPMENT IN NUCLEAR METALS. M. J. Lavigne (Canadian Westinghouse Co., Ltd., Hamilton, Ont.).

Contributions to research and development in nuclear metals are described. Welding of Zircaloy-2, static corrosion of Zircaloy-2, dynamic corrosion of nitrogen-contaminated Zircaloy-2, fabrication of 3-in.-thick-walled stainless steel vessel, joints between Zircaloy-2 and stainless steel, beryllium research, effects of hydriding on the mechanical properties of Zircaloy-2 foil, and brazing of Zircaloy-2 are discussed. (M.C.G.)

7890 (NP-11196(p.34-41)) MATERIALS RESEARCH AND DEVELOPMENT AT AECL. W. M. Campbell (Atomic Energy of Canada Ltd., Chalk River, Ont.).

Work on materials research being carried out at Chalk River is reviewed. Topics covered include creep of Zr alloys, high-strength Zr alloy development, effects of neutron irradiation on the mechanical properties of Zircaloy-2, hydriding Zr alloys, thermal diffusion of hydrogen in Zircaloy-2, use of tritium as tracer for studies of hydrogen in metals, study of boron distribution in metals by neutron activation, radiation effects on precipitate particles in metals, irradiation of ferritic irons and steels, effects of neutron irradiation on Cu-Be alloys, self-diffusion in single crystals of α-U, self-diffusion in pure Zr, behavior of inert gases in metals, electron microscopy of irradiated metal foils, and irradiation at low temperatures. (M.C.G.)

7891 (NP-11196(p.43-61)) MATERIALS RESEARCH AT THE MINES BRANCH, DEPARTMENT OF MINES AND TECHNICAL SURVEYS. R. L. Cunningham.

Studies on the effects of additions of niobium to carbon steels and on copper alloys are described. Graphs and tables are presented showing the effect of niobium on carbon steels. Dislocations and mechanisms of precipitation from solid solutions in copper alloys are described. Solute segregation during dendritic growth was also investigated. Ion bombardment of metal surfaces and properties of liquid metals are being studied. (M.C.G.)

7892 (NP-11196(p.85-8)) CORROSION STUDIES WITH SPECIAL REFERENCE TO WELDMENTS. J. U. MacEwan (McGill Univ., Montreal).

Studies on the corrosion behavior of steel weldments and the stress-corrosion cracking of brass are reviewed. (M.C.G.)

7893 (NP-11196(p.101-4)) EFFECTS OF STRAIN RATE AND TEMPERATURE ON DEFORMATION BEHAVIOR OF BODY-CENTERED CUBIC REFRACTORY METALS. F. A. Forward (British Columbia. Univ., Vancouver).

Work is being carried out to determine the tensile transition temperature for vanadium crystals and to determine the elastic modulus and various mechanical properties of single-crystal vanadium. Tantalum is being prepared to study its mechanical properties and strain-aging properties. (M.C.G.)

7894 (NP-11242) RESEARCH ON PHASE EQUILIBRIA BETWEEN BORON OXIDES AND REFRACTORY OXIDES, INCLUDING SILICON AND ALUMINUM OXIDES. Report 931-8. Quarterly Progress Report, July 1, 1961–September 30, 1961. P. J. Gielisse and W. R. Foster (Ohio State Univ. Research Foundation, Columbus). Oct. 18, 1961. Contract AF33(616)-6509. 12p.

Phase equilibrium in the ternary system Al_2O_3–B_2O_3–SiO_2 was investigated. Phase relationships were determined by the use of a modified quenching technique and solid-state sintering reactions. No ternary compounds were detected in the B_2O_3-rich portion of the system. Attempts to synthesize sillimanite ($Al_2O_3 \cdot SiO_2$) with the aid of boron oxide flux were unsuccessful. Liquidus and solid phase compatibility data are presented along with a tentative phase diagram. (M.C.G.)

7895 (ORO-461(Rev.)) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO VERY HIGH TEMPERATURES. Final Report. (Southern Research Inst., Birmingham, Ala.). July 28, 1961. Revised Oct. 28, 1961. Contract [AT(40-1)-2694]. 99p.

A facility was developed to determine the tensile strength and moduli of brittle materials at temperatures to 5200°F. Major advances in the state of the art were realized in the true uniaxial loading of tensile specimens by the use of gas bearings in the load linkage, high temperature strain measurements by a fully automatic and continuously recording optical system, and radiant heating of the specimen to over 5000°F by both induction and resistance element furnaces. The complete test facility was assembled, and many performance runs on several types of specimens were completed. The data obtained are included. All components

were evaluated, and the operating characteristics of the complete facility are considered to be excellent. Examination of the results indicated significant reductions in data scatter and higher strengths than previously reported for brittle materials. Also, continuous plots of the stress versus strain permit a detailed study of the variation of modulus over the full load range to specimen fracture. (auth)

7896 (TID-14631) [ANOMALOUS RESISTIVITY CHANGES ACCOMPANYING PLASTIC DEFORMATION IN Cu–Pd AND Ag–Pd ALLOYS. (Minnesota. Univ., Minneapolis). 1961]. Contract [AT(11-1)-1009]. 12p.

A study was made of the influence of cold working on the resistivity of Cu–Pd and Ag–Pd alloys. It was found in the case of Cu–Pd alloys that the initial resistivity varied with the annealing temperature, but all exhibited the same final resistivity. The Ag–Pd alloy showed no change in resistivity as a function of quenching temperature. Magnetic susceptibility measurements were made in Ag–Pd alloys. Studies were also made of the change in resistivity as a result of annealing after deforming at liquid nitrogen temperature. Ag–Pd specimens were prepared for Hall-Effect measurements. (M.C.G.)

7897 (WADC-TR-57-344(Pt.V)) DEVELOPMENT OF NIOBIUM-BASE ALLOYS. Richard T. Begley, William N. Platte, Allen I. Lewis, and Robert L. Ammon (Westinghouse Electric Corp. Research Labs. Pittsburgh). Jan. 3, 1961. Contract AF33(616)-6258. 134p.

The effect of oxygen and nitrogen additions on the hardness, workability, strain-hardening characteristics, and recrystallization behavior of niobium was determined. Nitrogen additions were found to be detrimental to cold rolling characteristics. Hardness, workability, and mechanical property data for Nb-C alloys were obtained. Grain boundary carbides were found to be very detrimental to cold workability. Carbon additions increased the ductile-brittle transition temperature range of niobium. Mechanical property data were obtained for many binary, ternary and quaternary niobium base alloys. Re, W, and Mo additions increased the ductile-brittle transition of niobium. A number of alloys were prepared by the consumable-electrode arc-melting process. Ingot breakdown was accomplished by high energy rate extrusion (Dynapak). The results of Dynapak extrusion were very encouraging. Several high strength alloys were investigated. One alloy, Nb-10W-5V-1Zr, had excellent room temperature ductility and ultimate tensile strengths of 64,800 psi and 29,450 psi at 1205 and 1315°C, respectively. Welding data for a number of Nb-base alloys are presented. (auth)

7898 (WADD-TR-60-143(Pt.II)) RESEARCH STUDY TO DETERMINE THE PHASE EQUILIBRIUM RELATIONS OF SELECTED METAL CARBIDES AT HIGH TEMPERATURES. R. T. Dolloff and R. V. Sara (National Carbon Co. Research Lab., Parma, Ohio). May 1961. Contract AF33(616)-6286. 19p.

The results are reported of an investigation of phase equilibria in the binary system tungsten–carbon. A tentative phase diagram is presented which differs significantly from the one proposed by Sykes in 1930 and which is generally accepted today. The data were obtained by high-temperature differential thermal analysis and classical quenching procedures, both supplemented by metallographic, x-ray, and chemical techniques. Results for the tungsten–carbon binary system indicate a eutectic between W and W_2C at 2735°C, and a eutectic between W_5C_3 and C at 2765°C. The W_2C lattice accommodates 72 and 74 atomic per cent W at 2475° and 2735°C, respectively. Carbon solubility is evident only at 2540°C, the eutectoid temperature. A new phase, W_5C_3, has been discovered which is stable only above 2540°C. WC decomposes at 2730°C into W_5C_3 and C. (auth)

7899 (WADD-TR-61-72(Vol.V)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME V. ANALYSIS OF CREEP AND RECOVERY CURVES FOR ATJ GRAPHITE. E. J. Seldin and R. N. Draper (National Carbon Co. Research Labs., Cleveland). May 1961. Contract AF33(616)-6915. 38p.

Flexural creep tests were made on specimens of ATJ graphite at temperatures ranging from 2300 to 3000°C. The creep curves were fitted by graphical and analytical means to four equations. Fairly good fits were obtained with all of the equations which were used. Attempts were made to determine the stress and temperature dependence of several of the parameters in the equations. Of the four equations which were used, one could be related to simple rheological models having some physical significance. A model was found useful not only in describing the creep curves, but also in describing the recovery after creep and relating the behavior in recovery to the behavior during creep. Generally good agreement was found between the qualitative predictions of the models and the observed behavior. Using a model, an activation energy for the steady state creep rate was determined to lie between 70 and 76 kcal/mole. Some deviations were detected between the actual behavior of the material and that predicted by the simple models which suggest some modifications that may be made to obtain a better model. The value of a model is discussed, and several additional experiments are suggested to supplement the information given by creep experiments. (auth)

7900 (AEC-tr-4468) STUDIES ON URANIUM–MOLYBDENUM ALLOY. Masayuki Kawasaki, Ryukichi Nagasaki, Motoo Itagaki, and Tatsuya Takemura. Translated from J. At. Energy Soc. Japan, 2: 136-40(1960). 28p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 14086.

7901 (AEC-tr-4980) THE INFLUENCE OF TEMPERATURE AND ALLOYING ADDITIONS ON THE SURFACE TENSION OF SILVER, COPPER AND COPPER ALLOYS. F. Pawlek, W. Thielsch, and W. Wuth. Translated from Metall, 15: 1076-8(1961). 12p.

Test results confirmed that silver additions reduce the surface tension of copper. Furthermore, it could be shown that high silver contents are required for this purpose. Copper-phosphorus alloys with and without silver additions were also studied. The results showed that the capillary constant and thus the surface tension decrease with an increasing phosphorus content. (auth)

7902 (CEA-tr-R-1404) DILATATION THERMIQUE DU PLUTONIUM. (Thermal Dilatation of Plutonium). N. T. Chebotarev (Tchebotarev) and A. V. Beznosikova (Beznossikova). Translated into French from Atomnaya Energ., 7: 68-9(1959). 10p.

The coefficients of thermal expansion of α-plutonium along various axes were determined in the temperature interval from −196 to 100°C. The crystalline parameters of the sample were determined at normal temperatures. The coefficients in the temperature interval indicated were determined from the displacement of various diffraction lines. The variation of the crystalline parameters with temperature is shown graphically. The coefficients of thermal expansion of α-plutonium along three reciprocally perpendicular directions and the mean expansion coefficient error in the temperature interval studied are tabulated. (J.S.R.)

7903 (HW-TR-30) METALLOGRAPHY—STUDY OF SELF-DIFFUSION OF URANIUM IN THE ALPHA PHASE. Yves Adda, Alexis Kirianenko, and Claude Mairy. Translated by R. L. Bush and S. H. Bush (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) from Compt. rend., 253: 445-7(July 17, 1961). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 2222.

7904 HIGH TEMPERATURE CHEMISTRY OF THE BINARY COMPOUNDS OF BORON. Paul W. Gilles (Univ. of Kansas, Lawrence). Advances in Chem. Ser., No. 32, 53-9(1961).

Methods of preparation; thermodynamic, chemical, and physical properties; and the uses of refractory borides are listed, described, and discussed. The present status of the field is assessed. (P.C.H.)

7905 THE SPECIFIC HEATS OF RARE EARTH METALS BETWEEN 0.5 AND 4°K. Bernard Dreyfus, Bruce Bailey Goodman, Albert Lacaze, and Gilbert Trolliet (Laboratoire de Basses Températures, Institut Fourier, Grenoble, France). Compt. rend., 253: 1764-6(Oct. 23, 1961). (In French)

The specific heats of Pr, Ho, Er, and Tm were measured between 0.5 and 4°K. Except for Pr, which does not seem to be magnetically ordered, the values of the coefficient of the hyperfine specific heat agree with those predicted by a model in which the rare earth ion is found in a state of maximum J. (tr-auth)

7906 THERMIONIC ENERGY CONVERTORS. B. A. Ušakov. Jaderná energie, 7: 401-3(1961). (In Czech)

The problems of direct conversion of nuclear energy into electricity by thermionic converters are discussed. Properties of materials containing fissionable substances and having good thermoemissivity are evaluated, and the results of converter testing in a reactor are reported. It is shown that a converter filled with inert gas operates as a cesium plasma diode and needs no cesium vapor. It is also possible to evacuate gases during operation. This evacuation prolongs the life and improves the characteristics of a thermionic converter. (auth)

7907 DIMENSIONAL STABILITY OF URANIUM IN THERMAL CYCLING. Věra Kovanicová (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 404-7(1961). (In Czech)

The influence of various factors on dimensional changes of thermal cycled alpha uranium is described. The mechanism of these changes is briefly given. (auth)

7908 BERYLLIDES FOR LIGHTWEIGHT, HIGH TEMPERATURE STRUCTURES. A. J. Stonehouse (Brush Beryllium Co., [Cleveland]). Materials in Design Eng., 55: No. 2, 84-6(Feb. 1962).

Three important properties of beryllides; modulus of rupture, oxidation resistance, and specific gravity, are discussed, along with fabrication methods; cold pressing and sintering, isostatic pressing and sintering, hot pressing, flame spraying, and extrusion and slip casting. The combination of low density, high temperature strength, and oxidation resistance suggests that principal interest in the beryllides will probably be in the aerospace industries. Applications might include leading edges and wing and body panels. (P.C.H.)

7909 NEW DEVELOPMENTS IMPROVE DUCTILITY OF BERYLLIUM. Richard Schmidt (Bureau of Naval Weapons, Washington, D. C.). Metal Progr., 81: 78-82 (Feb. 1962).

Ductile beryllium can be produced by zone refining to a low impurity level. High-strength beryllium wire with a tensile strength of 190,000 psi is thus developed. It may be useful for wrapped structures and for electrical applications. (auth)

7910 THE DISSOCIATION PRESSURE OF UC_2 AT HIGH TEMPERATURE AND THE THERMODYNAMIC PROPERTIES. Shiro Fujishiro (Fuji Iron & Steel Co., [Japan]). Nippon Genshiryoku Gakkaishi, 3: 913-17(Dec. 1961). (In English)

Pertinent thermodynamic properties of uranium dicarbide were investigated by measuring the dissociation pressure of uranium at high temperatures in the reaction $UC_2(s) = U(g) + 2\,C(s)$ by means of the Knudsen cell effusion method. The α counting method was employed to determine the weight of the condensate on the target. The dissociation pressure, P, is expressed by $\log P_U\ (atm) = -30{,}600/T + 6.36$ in the temperature range 2448 ~ 2731°K and, therefore, the standard free energy change $\Delta F^\circ = 140{,}000 - 29.12T$. Combining this with other thermodynamic data the heat of formation of UC_2 was estimated to be −33,240 cal in the same temperature range. (auth)

7911 NEUTRON DIFFRACTION STUDY OF IRON–COBALT ALLOYS. [PART] I. B. G. Lyashchenko, D. F. Litvin, and Yu. B. Abov (Inst. of Metal Science and Physics of Metals, USSR). Soviet Phys.-Cryst., 6: 443-7(Jan.-Feb. 1962).

Atomic ordering was studied in iron–cobalt alloys having a body-centered cubic lattice. An anomalously wide range of existence of the superlattice of the equiatomic composition FeCo: approximately from 25% Co to the $\alpha \rightleftharpoons \gamma$ transition line (~75% Co) was found. Analysis of the results leads to the conclusion that the "order-disorder" transition in this system is a second-order phase transition. (auth)

7912 STUDY OF THE CHANGES IN CRYSTAL STRUCTURE OF NICKEL–BERYLLIUM ALLOY AT AN EARLY AGING STAGE. Yu. D. Tyapkin, Yu. A. Bagaryatskii, and A. V. Gavrilova (Inst. of Metal Science and Physics of Metals and Central Ferrous Metals Research Inst., USSR). Soviet Phys.-Cryst., 6: 448-55(Jan.-Feb. 1962).

The structural mechanism of nickel–beryllium alloy aging after quenching and annealing at 425 and 550°C was studied by means of x-ray photographs of single crystals obtained in soft and hard characteristic radiations. The changes in crystal structure were compared with the hardness of the alloy after different aging conditions. The structural changes observed (formation of platelike Guinier-Preston zones, considerable rotation of the fragments of the matrix, destruction of continuity) are due to the considerable difference, attaining 20% in the atomic volumes of the matrix and precipitation phase (NiBe). The tendency to maintain the interconnection of regions of high and low beryllium content leads to the occurrence of high stresses in the crystal. (P.C.H.)

7913 THE STRUCTURES OF ThAl, PuNi, ThCo, CaAg AND THEIR RELATION TO THE CrB (TAB) AND TlI (YELLOW MODIFICATION) STRUCTURE TYPES. P. I. Kripyakevich (Lvov State Univ.). Soviet Phys.-Cryst., 6: 501-3(Jan.-Feb. 1962).

The characteristics of ThAl, PuNi, ThCo, and CaAg, along with several other compounds, are tabulated for convenience in comparing the structures. The axial ratios and lattice parameters are shown to be similar to one another. The mean values of a/c, b/c, Y_R, and Y_X are 1.02,

2.66, 0.143, and 0.429, respectively. The structures of the intermetallic compounds CaSn, ThCo, PuNi, and CaAg occupy an intermediate position between the structures with strongly pronounced chains of the type -X-X-X- (borides, silicides, ThAl) and the TlI structure, which is nearly molecular. It is concluded that there is a sound basis for considering the structures of all the compounds tabulated as belonging to the CrB–TlI structure type. (P.C.H.)

7914 THE PHASE DIAGRAM OF THE NIOBIUM–CARBON SYSTEM. Hirozo Kimura and Yasuo Sasaki (National Research Inst. for Metals, Science and Technics Agency, Tokyo). Trans. Japan Inst. Metals (Sendai), 2: 98-104(Apr. 1961). (In English)

This niobium-carbon system is investigated by melting point measurements, x-ray analyses, and microscopic examinations. An equilibrium diagram up to 63.5 atomic percent carbon is shown. The limit of carbon solubility in niobium (α) phase lies at about 2 atomic percent at 2000°C and it decreases abruptly as the temperature decreases. The $Nb_2C(\beta)$ phase has a very narrow range of homogeneity and the NbC(γ) phase exists in a wide composition range from 41 to 50 atomic percent carbon below 1400°C. Three non-variant reactions in this system are determined. (auth)

7915 PHASE ANALYSIS OF TITANIUM BASE ALLOYS. N. I. Blok, A. I. Glazova, N. F. Lashko, V. P. Kuraeva, and E. K. Molchanova. Zavodskaya Lab., 27: 1470-3(1961). (In Russian)

An electrochemical method was utilized in a phase analysis of α- and β-titanium alloys and titanium alloyed with active eutectoid elements. The isomorphous β stabilizers are distributed according to their stabilizing ability in Ti $\alpha + \beta$ alloys (Mo, V, Nb, and Ta respectively). The Ti_3Cu-type phase was observed in Ti–Al–Cu–Sn alloy containing 3.5% Cu. (R.V.J.)

7916 HARDNESS OF TRANSITION METAL NITRIDES. G. V. Samonov and T. S. Verkhoglyadova (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Zhur. Strukt. Khim., 2: 617-18(Sept.-Oct. 1961). (In Russian)

Systematic microhardness studies were carried out on Ti, Zr, V, Nb, Ta, and Cr nitrides prepared from powders under oxidation preventing conditions. The results are tabulated and analyzed. (R.V.J.)

7917 MECHANICAL PROPERTIES OF ENGINEERING CERAMICS. Proceedings of a Conference at Raleigh, North Carolina, March 9-11, 1960. W. Wurth Kriegel and Hayne Palmour, III, eds. New York, Interscience Publishers, 1961. 658p. $21.00.

Thirty-four papers are included; separate abstracts have been prepared for six. One paper was previously abstracted in NSA. The technical content is concerned with the experimental results and the research being accomplished on the mechanical properties of ceramics and related materials which are capable of serving as structural components in advanced engineering applications. This study includes information on imperfections, deformation processes, thermal stress, and mechanical properties of oxide ceramics, graphite, nonoxide ceramics, and composite materials. (N.W.R.)

7918 OBSERVATIONS ON Nb_2O_5 WHISKERS AND THEIR STRENGTH PROPERTIES. Joar Markali (Central Inst. for Industrial Research, Blindern, Norway). p.93-102 of "Mechanical Properties of Engineering Ceramics." New York, Interscience Publishers, 1961.

The crystallography, growth mechanism, elastic bending, and mechanical properties of niobium pentoxide whiskers are investigated. Although the crystal structure of alpha-niobium pentoxide is not known, it seems fairly probable that knowledge of the structure would indicate that the high strain values observed are caused not only by compression and stretching of chemical bonds but also in a variation in bond angles. The phenomenon is most likely reversible and can also account for the broken whiskers being straight. (N.W.R.)

7919 THE EVALUATION OF CERAMIC MATERIALS UNDER THERMAL SHOCK CONDITIONS. Jesse D. Walton, Jr. and M. D. Bowen (Georgia Inst. of Tech., Atlanta). p.149-73 of "Mechanical Properties of Engineering Ceramics." New York, Interscience Publishers, 1961.

The properties of engineering ceramics which determine their relative performance under thermal shock conditions are reviewed, and the need for developing better methods of simulating aerodynamic heating and determining the resulting thermal stresses is emphasized. The test method using the exhaust of a small oxygen–hydrogen rocket motor is described. The effect of temperature on the strength of alumina, Pyroceram, and slip-cast fused silica is included in thermal stress formulas to predict thermal failure. These data are compared with the thermal shock resistance as determined from simulated test data. The results show that slip-cast fused silica is superior to Pyroceram which is in turn superior to alumina. Thus, based on mechanical and electrical property data, slip-cast fused silica should prove to be an excellent radome material for missile applications where high rates of heating are anticipated. The mechanical properties which are specified for ceramic radome materials are discussed and suggestions of additional properties which would better define a material are suggested. (N.W.R.)

7920 REINFORCED REFRACTORY CERAMIC COATINGS FOR RAMJET AND SUPERSONIC AIRCRAFT APPLICATIONS. Samuel Sklarew (Marquardt Corp., Van Nuys, Calif.). p.191-205 of "Mechanical Properties of Engineering Ceramics." New York, Interscience Publishers, 1961.

The limitations of currently available materials for ramjet combustion chambers are reviewed and related to the development of reinforced ceramic coatings. Reinforcement, ceramic fillers, bonding agents, and coating preparation are discussed. Details of test procedures and results are presented. The properties of reinforced aluminum phosphate-bonded alumina and zirconium phosphate-bonded zirconia are given. (N.W.R.)

7921 THE ELASTIC AND ANELASTIC PROPERTIES OF REFRACTORY MATERIALS FOR HIGH-TEMPERATURE APPLICATIONS. R. Chang (Atomics International, Canoga Park, Calif.). p.209-20 of "Mechanical Properties of Engineering Ceramics." New York, Interscience Publishers, 1961.

Examples of anelastic phenomena associated with grain boundary relaxation, twin interface motion, or dislocation motion in some refractory oxides and other high-temperature materials are presented. The significance of such studies in providing fundamental information about detailed mechanisms of deformation in ceramic materials is discussed. The materials of which the elastic and anelastic properties are given are: aluminum oxide, beryllium oxide, magnesium oxide, zirconium hydride, zirconium oxide, sapphire, $NbBe_{12}$, and graphite crystals. (N.W.R.)

7922 SOME THERMAL AND MECHANICAL PROPERTIES OF DENSE BERYLLIUM OXIDE. S. C. Carniglia (Atomics International, Canoga Park, Calif.). p.239-44 of "Mechanical Properties of Engineering Ceramics." New York, Interscience Publishers, 1961.

Recent measurements of modulus of rupture, thermal expansion, and thermal conductivity of very dense high-purity beryllium oxide are given, as well as the computed index of thermal stress resistance. The data are contrasted with earlier measurements on beryllium oxide and with properties of aluminum oxide and stabilized zirconium oxide. (auth)

7923 HIGH-TEMPERATURE TORSIONAL SHEAR PROPERTIES OF A MOLDED GRAPHITE. Leon Green, Jr. (Ford Motor Co., Newport Beach, Calif.), Melvin L. Stehsel, and Cecil E. Waller. p.407-28 of "Mechanical Properties of Engineering Ceramics." New York, Interscience Publishers, 1961.

The results of stress-strain, creep, and stress relaxation measurements on specimens of a polycrystalline molded graphite (grade H4LM) stressed in torsion at temperatures up to 2800°C are reviewed. The strength and static shear modulus data show the same temperature dependence as the corresponding tensile data. The effects of strain rate, strain history, and grain orientation are discussed, and the inelastic behavior is interpreted in terms of a mechanism for plastic deformation postulated by Mrozowski. (auth)

Radiation Effects

7924 (ANL-6397) IRRADIATION OF METAL-FIBER-REINFORCED THORIA–URANIA. Final Report–Metallurgy Program 6.2.4. L. A. Neimark, J. H. Kittel, and C. L. Hoenig (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-eng-38. 49p.

Randomly oriented fibers of either molybdenum or niobium were incorporated into hot-pressed pellets of 10, 30, and 50 wt % UO_2 in ThO_2 to improve thermal conductivity and thermal shock resistance. Pellets, 9.5 mm in diameter and 9.5 mm in length, were irradiated in NaK capsules, both bare and jacketed with Zircaloy-2, with the annulus between pellet and jacket filled with lead or helium. They were irradiated to burnups ranging up to 34,500 Mwd/T (1.0×10^{21} fiss/cc) at central temperatures of the order of 3000°C. Integral $kd\theta$ values ranged from 34 to 129 w/cm. Fracture and metallographic sections of the irradiated specimens confirmed out-of-pile measurements that the molybdenum fibers increased the effective thermal conductivity of the mixed oxides. It was possible to give the fibered pellets higher heat ratings than unfibered pellets before comparable thermal effects occurred. The fibers tended to reduce central void formation, retard recrystallization, and maintain the integrity of the pellet. In some helium-bonded specimens, the molybdenum fibers coalesced into a central sphere after melting during irradiation. The coalescence did not occur in lead-bonded specimens. The niobium fibers were found to react with the oxide. Fission gas release from unclad fibered pellets was a maximum of 15.3% of theoretical at a burnup of 31,500 Mwd/T (8.3×10^{20} fiss/cc) and an integral $kd\theta$ value of 57 w/cm. Gas release from similarly irradiated unfibered pellets was a maximum of 6.3% at 21,800 Mwd/T (6.6×10^{20} fiss/cc) and an integral $kd\theta$ value of 92 w/cm. The disparity in gas release is attributed to the breaking into pieces of the unfibered pellets early in the irradiation and their consequent operation at significantly lower temperatures than the fibered pellets. (auth)

7925 (DC-55-11-11) ANALYSIS OF RADIATION DAMAGE TO ELECTRIC COMPONENTS CONTAINING WIRE-WOUND COILS. W. J. Stapp and C. G. Collins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 1955. Contract AT(11-1)-171. 43p.

A compilation of data is presented concerning the radiation stability of construction materials for use in electric motors, selsyns, solenoids, transformers, and other devices containing wire-wound coils. (J.R.D.)

7926 (DC-55-12-81) SURVEY AND EVALUATION REPORT OF RADIATION DAMAGE TO ORGANIC LIQUIDS. PART IV. MILESTONE III, TASK 1409. C. G. Collins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 12, 1955. Contract AT(11-1)-171. 131p.

A survey and analysis of the existing data on radiation damage to organic liquids was made. The results are presented in tabular and graphical form and are discussed briefly in relation to the problems that may arise in engineering applications. Dosages are presented in various equivalent units to aid in estimating the useful life of a liquid in a given radiation field. (auth)

7927 (DC-58-11-168) RADIATION AND TEMPERATURE TESTS OF MINIATURE TRANSISTOR AMPLIFIERS. James E. Mott (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 20, 1958. Contract AT(11-1)-171. 48p.

Results of radiation and temperature tests are presented for two types of miniature transistor amplifiers. Performance curves are shown, and an analysis of the results leading to a possible method of failure prediction is given. One of the amplifier types was successfully tested at 150°C with gamma irradiation of 4.7×10^7 roentgens, and a fast-neutron dosage of 7.0×10^{12} nvt (epicadmium). These results place the use of such an amplifier, as an airframe-mounted control component, within the realm of feasibility. (auth)

7928 (DC-59-3-183) NUCLEAR RADIATION AND ELECTRONIC EQUIPMENT. J. R. Crittenden (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 17, 1959. Contract AT(11-1)-171. 15p.

The problems associated with designing electronic equipment with tolerance to nuclear radiation are discussed. Procedural recommendations are given. (auth)

7929 (DC-59-10-116) THE IRRADIATION AND TENSILE PROPERTIES OF A MAGNESIUM–THORIUM ALLOY: LTMT AND XMT TEST SERIES. R. C. Lee (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 8, 1959. Contract AT(11-1)-171. 62p.

Tests were carried out to determine the effects of radiation on the crystal structure and tensile properties of a Mg–Th alloy. Data are presented in tabular form. (M.C.G.)

7930 (DC-60-8-122) SOLID STATE PHYSICS SERIES: FISSION FRAGMENT ABSORPTION FRACTIONS AND DISTRIBUTIONS IN TWO-REGION SLAB SYSTEMS. J. R. Beeler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 1960. Contracts AF-33(600)-38062 and AT(11-1)-171. 25p.

The absorption fractions and absorption point distributions for particles in a two-region slab system were derived on the basis of a fixed-range, isotropic source model. These results are pertinent to the interpretation of laboratory experiments on the release of heavy charged particles from solids and the output of Monte Carlo Program 0576 for fission fragment recoil loss. (auth)

7931 (DC-60-8-124) SOLID STATE PHYSICS SERIES: CALCULATIONS ON FISSION FRAGMENT AND PRODUCT LOSS FROM FUEL ELEMENTS. J. R. Beeler and J. L.

McGurn (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 1960. Contracts AF 33(600)-38062 and AT(11-1)-171. 19p.

The results of GE-ANPD Monte Carlo and diffusion calculations on fission fragment and product loss made prior to July 1, 1960, are summarized. These calculations indicated that radiation enhancement of bulk diffusion for I^{131} is unimportant relative to the magnitude of the diffusion coefficient required to explain the experimentally determined steady state, temperature dependent, diffusion loss. They also indicated that the radiation enhancement mechanism can not be used to explain the short-time burst release associated with temperature excursions in any material, containing nuclear fuel, that has previously experienced neutron irradiation. A recoil loss fraction of 0.02 percent was predicted for inpile tests at 3 to 4 atm pressure and about 4.5 times this fraction was predicted for high pressure tests. The diffusion calculations indicated that the diffusion loss current will exceed the recoil loss current in slabs provided the diffusion coefficient is greater than 5×10^{-13} cm/sec. The dominant steady state diffusion mode for I^{131}, therefore, cannot be bulk diffusion, even at high temperatures. (auth)

7932 (DC-60-10-16) SOLID STATE PHYSICS SERIES: FISSION FRAGMENT ABSORPTION AS A FUNCTION OF COOLING GAS PRESSURE AND TEMPERATURE. J. R. Beeler and J. L. McGurn (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). September 30, 1960. Contract AT(11-1)-171. 13p.

Computational results for fission fragment absorption in a two-region system composed of a solid matrix containing isolated circular cylinders filled with a streaming fluid are summarized. Regional absorption fractions and distributions are given in tabular form for a fluid pressure range of 1 to 20 atm and a fluid temperature range of 1500 to 2600°F. The computations were done using GE-ANPD Monte Carlo Program 0576. Two examples were worked out to illustrate how the tabulated results may be applied to a specific problem. (auth)

7933 (DC-60-12-95) COMBINED RADIATION–TEMPERATURE EFFECTS ON HOSE AND SEAL ELASTOMERS (MILESTONE REPORT). C. G. Collins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 30, 1960. Contract AT(11-1)-171. 40p.

Results are reported of tests of four elastomers, Viton-A, Viton-B, Buna-N, and LS-53, subjected to combined radiation and temperature exposure in air and in OS-45 hydraulic fluid. Properties measured after exposure included tensile strength, percent elongation, and hardness. From a comparison of radiation induced changes with those produced in similar non-radiation exposures, it appears that Buna-N components such as hoses should last as long under irradiation as under non-radiation conditions at temperatures up to about 300°F. However, comparison of the materials on the basis of retention of rubber-like properties indicates that superior high-temperature components can be obtained with the Viton compounds by de-rating standard components or by designing specifically for radiation conditions. The LS-53 material does not appear acceptable in OS-45 hydraulic fluid for either radiation or non-radiation conditions. (auth)

7934 (GEAP-3808) MARITIME LOOP IRRADIATION PROGRAM. SAVANNAH I FUEL IRRADIATION; QUARTERLY PROGRESS REPORT, APRIL 1, 1961–JUNE 30, 1961. D. W. Danielson (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Aug. 25, 1961. Contract AT(04-3)-189. 12p.

The S-I-5-B-M fuel irradiation in the GETR Maritime Loop is described. Discussions on fuel performance, fuel environment, problems with loop operations, and sample station modifications are included. Typical operating and coolant conditions are described. The water chemistry conditions are discussed. (M.C.G.)

7935 (NMI-1249) IRRADIATION BEHAVIOR OF METASTABLE BETA PHASE URANIUM-BASE ALLOYS. FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Interim Technical Report to United States Atomic Energy Commission, July 1, 1960–June 30, 1961. H. M. Green and W. B. Nowak (Nuclear Metals, Inc., Concord, Mass.). Aug. 18, 1961. Contract AT(30-1)-1565. 30p.

A study of the swelling behavior of neutron irradiated metastable beta-phase uranium-base alloys was undertaken in an effort to determine whether such materials possessed the necessary volume stability of a potential fuel for power reactor applications. Materials irradiated were unalloyed uranium, U–0.3 wt % Cr, and U–0.3 wt % Cr–0.3 wt % Mo, with various metallurgical histories. Expected irradiation conditions were approximately 450°C central metal temperature, 0.01 and 0.3 at.% burnups of total uranium atoms, and a thermal neutron flux of 10^{13}/cm^2/sec. The experimental program is described, and the results available thus far are reported with a limited analysis of the data. (auth)

7936 (NP-11139) QUANTUM THEORY OF THE ČERENKOV RADIATION IN PLASMAS. Taro Kihara, Osamu Aono (Tokyo Univ.) and Taro Dodo (Hitachi, Ltd. Central Research Lab., Tokyo). [1961]. 15p.

Quantum electrodynamics for anisotropic dispersive media has been developed and applied to the Cherenkov radiation from a fast moving charge in a magneto-plasma. The radiation loss caused by first-order transitions agrees with the result classically obtained from the work done by the charge, the final expression containing no Planck's constant. (auth)

7937 (NP-11198) MONTHLY ACCESSION LIST NO. 53, [ON RADIATION EFFECTS DATA], NOVEMBER 1–NOVEMBER 30, 1961. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Dec. 15, 1961. 22p.

Annotated citations are presented for 66 references to reports and published articles on organic and inorganic compounds, electronic systems, polymeric materials, metals and ceramic materials, dosimetry, facilities, and space environs. (B.O.G.)

7938 (NP-11277) RESEARCH ON SOLID STATE RADIATION-INDUCED PHENOMENA. Quarterly Progress Report No. 7, August, September and October 1961. Hartmut Kallmann (New York Univ., New York). Nov. 1961. Contract DA 36-039-SC-85126. 36p.

A thorough investigation of decay curves was performed at both room and low temperatures. Two phosphors were investigated, ZnS(Ag) 2030 and ZnS–Cu 2040. The experimental results were compared with the Schön-Klasens model assuming two types of levels in the forbidden gap (traps and activators). It was found that both phosphors apparently have 4 decay mechanisms as already proposed in the model. The fluorescence always decays with twice the exponent of the conductivity. Decay curves beginning at various equilibrium intensities merge into an intensity independent point as can be seen from the Schön-Klasens equations. β, the radiative recombination factor, is probably independent of intensity but dependent upon temperature. The equipment and procedures for preparation of organic mixed crystals by the Bridgman method are re-

ported in detail. Mixed crystals which contain naphthalene, durene, and biphenyl as host materials and anthracene, naphthalene, terphenyl, and biphenyl as guest materials were prepared. Several clear or almost clear crystals with less than 0.5 wt % of the guest materials in the original dosage were obtained for each combination. Distributions of concentrations in mixed crystals were not uniform but increased gradually from the bottom to the top. The middle parts had almost uniform concentration, but their values were much less than the average concentrations. When a d-c field is applied to an excited ZnS phosphor, there is a temporary change in the luminescence. Two samples were investigated; a ZnS:Cu,Al which showed temporary enhancement, and a ZnCdS:Mn which showed a temporary quenching. The effects of varying the excitation wavelength and the applied voltage showed that the ZnCdS:Mn can also show enhancement under certain conditions. (auth)

7939 (SCTM-199-61(11)) ENGINEERING ASPECTS OF THE EFFECT OF NEUTRON IRRADIATION UPON TIN TRANSFORMATION. G. L. Eggert (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Contract [AT(29-1)-789]. 11p.

The effect of low-temperature reactor irradiation on the kinetics of beta-tin to alpha-tin transformation was experimentally determined. Exposures were nominally 10^{15}, 10^{16}, 10^{17}, and 5×10^{17} NVt (greater than 1 kev). Samples were unalloyed tin electroplated over copper substrates, per SC 400123. The irradiations had no measurable effect on either the incubation time or rate of transformation of individual nucleation sites. An increase in the number of nucleation sites throughout a sample surface was caused by all irradiation exposures. (auth)

7940 (TID-14745) A STUDY OF RADIATION DAMAGE RESULTING FROM ELECTRON BOMBARDMENT. J. W. Kauffman (Northwestern Univ., Evanston, Ill. Technological Inst.). Jan. 10, 1962. Contract AT(11-1)-89. 23p.

Progress is reported on developments in studies of radiation damage production and recovery in various metals, volume changes in copper, migration energies of electron-irradiated cadmium and gold, and recovery of electron-irradiated gold above −80°C. A list is included of modifications to the Van de Graaff accelerator made to improve its versatility, dependability, and precision. (B.O.G.)

7941 (TID-14763) KAPL IN-PILE TESTS OF ZIRCALOY. E. E. Baldwin (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract [W-31-109-eng-52]. 16p.

Presented at the AEC Meeting on In-Pile Creep of Zircaloy at BMI−January 23, 1962.

A research program to conduct in-pile tensile and creep tests of Zircaloy-4 in water at 500 to 600°F is outlined. An in-pile test assembly for carrying out the tests is described; the loading mechanism, strain-measuring system, sample holder, and errors are discussed. (D.L.C.)

7942 (AEC-tr-4679) MEASUREMENT OF THE ELECTRICAL RESISTANCE OF MOLYBDENUM UNDER IRRADIATION IN THE RFT REACTOR. A translation of "Izmerenie Elektrosoprotivleniya Molibdena v Protsesse Oblucheniya v Reaktore RFT." A. N. Ivanov and N. F. Pravdyuk (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960.

A method for measuring the electrical resistance of metals directly under irradiation in a reactor was developed. Measurement of the electrical resistance of molybdenum after integral doses of fast neutrons up to 2×10^{19} n/cm^2 in the core of the RFT reactor with temperatures in the order of 100°C showed that the increase in electrical resistance is a function of the integral dose and follows Mattissen's rule, i.e., does not depend on temperature in the range investigated (20 to 135°C) for a given radiation dose. (auth)

7943 EFFECT OF MONOENERGETIC 14.2 MEV NEUTRON IRRADIATION ON THE CONDUCTIVITY OF GERMANIUM. (PRELIMINARY NOTE). B. Saftić, M. Varićak, and M. Zuppa (Institute "Ruder Bošković," Zagreb). Glasnik mat.-fiz. i Astron., Ser. II, 16: 121-3 (1961). (In English)

Conductivity of n-type Ge at 30°C was analyzed as a function of the time-integrated flux of 14-Mev neutrons. After 15 hours of irradiation, the conductivity change was only 0.75%. The carrier removal rate was about 25 per incident neutron. Possibilities of determining the dependence of the carrier removal rate on the initial carrier concentration and the energy levels introduced by the neutron bombardment are indicated. (L.N.N.)

7944 HOW RADIATION AND HEAT AFFECT PERMANENT MAGNET MATERIALS. R. S. Sery, R. H. Lundsten, and D. I. Gordon (Naval Ordnance Lab., [White Oak, Md.]). Materials in Design Eng., 55: No. 1, 90-2; 133 (Jan. 1962).

Thirteen common permanent magnetic materials are shown to exhibit a wide variation in their resistance to high levels of irradiation and temperature. The results also show that none of the permanent magnetic materials are affected at irradiation levels below 3×10^{17} n/cm^2. The materials are exposed to temperature levels of 140, 455, and 655°F with and without radiation. It is shown that a magnetic material can be completely demagnetized if its curie temperature is exceeded in a sealed container inadequately cooled. (N.W.R.)

7945 IRRADIATION CONTROL OF OXIDATION STATE IN FLUORITE CRYSTALS CONTAINING SAMARIUM. J. Konitzer, J. Longo, R. Jarka, and H. N. Hersh (Zenith Radio Corp., Chicago). Nature, 193: 157-8(Jan. 13, 1962).

It was found that x irradiation of Sm-doped CaF_2 crystals increases the proportion of Sm^{2+} at the expense of Sm^{3+}, and it is suggested that x irradiation be used in the manufacture of more efficient optical maser materials. (D.L.C.)

7946 DIRECT OBSERVATION OF RADIATION DAMAGE. F. P. Bowden and L. T. Chadderton (Cavendish Lab., Cambridge, Eng.). New Scientist, 12: 559-61(Nov. 30, 1961).

An electron microscopic method is devised for observing directly the molecular disorder produced in a crystal when a heavy atomic particle is fired through it. The method is valuable for studying radiation damage, but the smallest distance it can see is perhaps 5 or 6 angstroms. The method is illustrated by using a crystal of platinum phthalocyanine. (N.W.R.)

7947 ANOMALOUS GAMMA-RAY INDUCED COLOURING OF SOME GLASSES CONTAINING CERIUM. Adli M. Bishay (Argonne National Lab., Ill.). Phys. and Chem. Glasses, 2: 169-75(Oct. 1961).

A new color center giving an absorption band at about 1.9 ev (650 mμ) was shown to be induced by gamma radiation in certain borate and silicate glasses containing cerium, most of which is in the cerous state. The intensity of the 1.9 ev band increases with increasing cerium content in glasses melted under strongly reducing conditions. The intensity of this band increases rapidly to a maximum with exposure to gamma radiation, and then changes in an oscillatory manner with increasing exposure. The new color center is tentatively designated as $(Ce^{3+} + e)$ in which the

number of cerous ions and the number of electrons involved in the formation of the center are unknown. This center is unstable, as shown by the high rate of fading, and is suppressed in the presence of Ce^{4+} ions. This explains the need of having Ce^{4+} ions along with Ce^{3+} ions in order to suppress visible induced absorption. It is postulated that while the Ce^{3+} ions suppress the induced positive hole centers, which give an absorption band at about 2.3 ev (550 mμ), the Ce^{4+} ions would suppress the formation of the new (Ce^{3+} + e) center which gives the 1.9 ev (650 mμ) band. (auth)

7948 APPLICATION OF THE DIFFUSION THEORY TO THE BIMOLECULAR REACTIONS. V. V. Antonov-Romanovskii (Antonov-Romanovsky) (Lebedev Inst. of Physics, Moscow). Phys. Rev., 125: 1-3(Jan. 1, 1962).

The solution of the nonlinear diffusion equation describing the process of recombination can be reduced to the solution of two more common equations—one linear diffusion equation without the recombinational member and one nonlinear equation which can be easily integrated. The proportion of recombinations between "congeneric" and "foreign" pairs, i.e., the role of monomolecularity or bimolecularity in the recombination process, is taken into account automatically by the initial conditions. In the later stage (if the excitation is uniform over the whole volume) the recombination process is simply bimolecular. At the decrease of the excitation the monomolecularity increases but never reaches 100%. In the case of the stationary weak excitation the concentration of divided particles is proportional to the square root of the intensity of the excitation. (auth)

7949 ENHANCED THERMAL EXPANSION IN X-RAYED ROCKSALT. M. F. Merriam, D. A. Wiegand, and R. Smoluchowski (Carneigie Inst. of Tech., Pittsburgh). Phys. Rev., 125: 52-64(Jan. 1, 1962).

The volume expansion of NaCl heavily irradiated at room temperature with penetrating x rays was studied using a photoelastic technique. A new effect was found; the coefficient of thermal expansion of NaCl is increased by irradiation. The magnitude of the fractional increase in expansion coefficient is typically less than 1%, and is about 14 times the concentration of radiation-induced defects, as measured by the volume expansion. The thermal annealing, above room temperature, of the enhancement of expansion coefficient was observed; within experimental error the effect anneals concurrently with the volume expansion. The increase in expansion coefficient seems to be correlated only with the total concentration of lattice point defects, and is rather insensitive to their electronic state and spatial distribution. Complete understanding of the effect in terms of a microscopic model was not achieved, but the algebraic sign and approximate magnitude of the enhancement can be calculated thermodynamically from the local strain field of a vacancy or an interstitial. A rough dynamical calculation, using a modified Einstein model to represent the lattice vibrations, indicates that the dominant term in the enhanced thermal expansion involves the mixed derivative $(d/dt)(\partial W_s/\partial V)_T$, where W_s is the activation energy for formation of Schottky defects. This quantity, as estimated from the data, is equal to 2×10^8 dynes/cm^2-deg. (auth)

7950 IMPROVEMENTS RELATING TO THE FORMATION OF P-N JUNCTIONS IN SEMI-CONDUCTOR MATERIAL. Douglas Richard Chick and Stanley Ernest Hunt (to Associated Electrical Industries, Ltd.). British Patent 886,232. Jan. 3, 1962.

A method is outlined for forming p-n junctions in semiconductor material. In this method, the surface of a body of monocrystalline semiconductor of one conductivity type is irradiated with protons to transmute atoms on and adjacent to the irradiated surface into an activator impurity of a conductivity type opposite to that of the body. (D.L.C.)

PHYSICS

General and Miscellaneous

Refer also to abstract 7906

7951 (AFOSR-1520) NOTE ON THE AXISYMMETRY OF AN ELECTRODELESS DISCHARGE. H. G. Loos and R. P. Treat (Giannini Scientific Corp., Santa Ana, Calif.). Aug. 1961. Contract AF49(638)-1014. 7p.

The vacuum electric field in an electrodeless discharge configuration is found to be strongly nonaxisymmetric. The polarization of the gas inside the coil, however, completely compensates the nonaxisymmetric component, thereby producing an axisymmetric field. (auth)

7952 (DC-60-12-141) AREA MOMENT OF INERTIA OF A CLADDED TRIFLUTE CONFIGURATION. B. Kaplan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 23, 1960. Contract AT(11-1)-171. 19p.

The moment of inertia of a cladded triflute plane area was developed in general terms so that the results are applicable to other triflutes with different dimensions but the same geometry. (auth)

7953 (LA-2625) PLASMA BROADENED LINES AND OSCILLATOR STRENGTHS OF CESIUM. Philip M. Stone (Los Alamos Scientific Lab., N. Mex.). Nov. 1961. Contract W-7405-Eng-36. 85p.

Plasma-broadened line shapes of the fundamental series of cesium are calculated. Plasma conditions include temperatures in the region 10^3 to 10^4 °K and ion and electron densities of 10^{13} to 10^{16} particles/cc. The electron interactions are treated in the impact approximation and the ion interactions in the static approximation. The electron motion is considered in the classical path approximation. Only isolated lines are calculated. The validity conditions for these approximations are shown to be satisfied. One-electron wave functions and matrix elements for cesium are calculated from a central potential. Spin-orbit splitting, hyperfine splitting of the ground state, and oscillator strengths are calculated and compared with experiment. Calculated line shapes are shown to agree with experiment, and graphs of width and shift versus perturber density are presented. Densities obtained by measuring line widths are compared with densities obtained by measuring recombination radiation. (auth)

7954 (LAMS-2649) ENERGY LEVELS IN CESIUM. Bob E. Watt (Los Alamos Scientific Lab., N. Mex.). Dec. 15, 1961. Contract W-7405-Eng-36. 10p.

An electrodeless discharge in cesium vapor has been observed with a Cary MR-14 spectrophotometer, and transitions from high $S_{1/2}$ levels identified. The term values obtained from the transitions to the $6P_{1/2}$ and $6P_{3/2}$ levels agree within the experimental error. (auth)

7955 (PR-P-51) PHYSICS DIVISION PROGRESS REPORT, JULY 1 TO SEPTEMBER 30, 1961. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 73p. (AECL-1408)

Various projects in physics are summarized. The lifetime and electric quadrupole strength of the transitions of the 3.85-Mev level in C^{13} were determined. The electric quadrupole strength of the 1.56-Mev level transition in F^{19} was measured relative to Al^{27}. The parities of the $O^{16}(C^{12},\alpha)$ and $O^{16}(O^{16},\alpha)$ reactions for various energy levels were determined from angular distributions. Proton polarizations were measured for four C^{13} levels following the $C^{12}(d,p)$ reaction at 3.5 to 8 Mev. Work on the Xe^{125} decay scheme is described. A preliminary investigation of the K-LL Auger spectrum of I^{125} is reported. Lifetimes were measured for Xe^{125}, Xe^{129}, and Xe^{133}. The energies of the three high-energy γ rays and of the 468-kev γ ray in Ir^{192} decay were measured. Measurements of the internal conversion coefficients for the 166-kev γ transition in La^{139} are reported. No evidence was found for a Kohn effect in sodium. Studies were made on phonons in pyrolytic graphite and rotational properties of some organic solids. A neutron diffraction study of FeSi gave no evidence of antiferromagnetism. Observations of a study of the Mossbauer effect in iron compounds are summarized. Various electronics projects are described, e.g., reactor instrumentation and data processing. Current work on the neutron spectrum in infinite gases is described. Computer studies were made of three problems on the elastic behavior of rectangular plates. Results of optical model fittings of proton elastic scattering angular distributions for seven elements are described. (D.L.C.)

7956 (TID-13041) PROGRESS REPORT NO. 57 [ON NUCLEAR RESEARCH] COVERING THE PERIOD FOR PHYSICS AND CHEMISTRY THROUGH OCTOBER 31, 1960. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Nov. 1, 1960. Contracts AT(30-1)-2098; AT(30-1)-905; NASw-37; and NASw-75. 145p.

Progress is reported on research in the chemistry of the fission elements, nuclear chemistry, cosmic radiation, high-energy accelerator physics, bubble chambers, linear accelerators, Rockefeller Generator, ONR Generator, radioactivity, cyclotrons, and theoretical nuclear science. (M.C.G.)

7957 (TID-14392) LOW TEMPERATURE CHEMICAL THERMODYNAMICS PROJECT TECHNICAL PROGRESS REPORT NO. 9, NOVEMBER 1960–NOVEMBER 1961. (Michigan. Univ., Ann Arbor. Dept. of Chemistry). Nov. 14, 1961. Contract AT(11-1)-70. 37p.

Progress is reported on the measurement of low-temperature thermodynamic properties of pure substances and systems from 5 to 350°K. Experimental results are discussed for the thermal properties of pentaerythrityl fluoride, transition metal hexafluorides, tetramethylmethane–tetrachloromethane systems, and triethylenediamine. (B.O.G.)

7958 (TID-14789) AN INVESTIGATION OF ENTHALPY DATA FOR WATER AND WATER VAPOR IN THE CRITICAL REGION. Technical Report No. 10. E. S. Nowak and R. J. Grosh (Purdue Univ., Lafayette, Ind. School of Mechanical Engineering). Sept. 1961. Contract AT(11-1)-1026. 112p.

The available smoothed and experimental data for the enthalpy of water and water vapor in the region of pressures ranging from about 2850 to 4300 psia (200 to 300 kg/cm^2) and for temperatures from 680 to 752°F (360 to 400°C) were compiled and analyzed. In general, good agreement was found between the smoothed values of enthalpy of various steam tables. However there are significant deviations near the critical point and in the region of the inflection temperature on isobars of enthalpy versus temperature. Enthalpy values were derived from the available experimental results on the specific heat at constant pressure. The values so derived are in excellent accord with direct measurements of enthalpy. It was also possible to con-

struct an isenthalpic diagram for water and water vapor in the critical region. (auth)

7959 (UCRL-9871) FORTRAN PROGRAM HOUND: CALCULATING A GENERAL BEAM AVERAGE OR GEOMETRIC CORRECTION FOR SECONDARIES ESCAPING FROM A RECTANGULAR BUBBLE CHAMBER. Alan Natapoff (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 4, 1961. Contract W-7405-eng-48. 47p.

Fortran program HOUND was developed to calculate beam averages and geometrical corrections in a rectangular (bubble) chamber given the dimensions of the chamber and the distribution of the beam. (auth)

7960 (AEC-tr-4741) KINETIC THEORY OF SHOCK WAVES. A translation of "K Kineticheskoi Teorii Udarnykh Voln." G. Ya. Lyubarskii (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 7p. Published in Zhur. Eksptl. i Teoret. Fiz., 40: 1050-7(Apr. 1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20285.

7961 (AEC-tr-4991) X-RAY DETERMINATION OF THE ELECTRON DISTRIBUTION IN CRYSTALS. V. THE ELECTRON DISTRIBUTION IN CALCIUM FLUORIDE. A. Weiss, H. Witte, and E. Wolfel. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. from Z. physik. Chem. (Frankfurt), 10: 98-132(1957). 40p.

The total reflectance of 105 reflections up to $\Sigma h^2 = 212$ was determined on plane-parallel, polished, single-crystal plates of CaF_2. The strongest reflections were measured by direct irradiation, and the weakest by surface reflections. The single crystal showed considerable extinction effects so that the structure amplitudes of the 11 strongest reflections were derived from the powder measurements. A smooth curve was drawn through the totality of the experimental points F_{exp}, and the value of F_{symm} used for the calculation of the electron density was taken from these curves. In the region of small values of $\sin\theta/\lambda$, these show systematic deviations as compared to the theoretical structure amplitudes $F_{theor.}$. The electron densities calculated by means of F_{symm} in the x y o, x y $\frac{1}{4}$ and x x z planes showed peculiarities. While the electron density in the x y o plane between the calcium ions was practically zero within a very large region and there was an electron fraction of only 0.2 electrons/A^3 in this plane in the direction of the diagonal surfaces, the electron density in the x y $\frac{1}{4}$ plane between the fluorine atoms did not drop to zero at any place, but rather was 0.2 electrons/$Å^3$ on the average. (auth)

7962 (CEA-tr-A-965) FLUORESCENCE DES GAZ EXCITES PAR DES PARTICULES ALPHA. (Fluorescence of Gases Excited with Alpha Particles). A. E. Gruen and E. Schopper. Translated into French from Z. Naturforsch., 6a: 698-700(1951). 10p.

The fluorescence of gases excited by individual α particles was studied with the aid of photomultipliers. Of the "technically pure" gases, N_2 and Ar give quantum yields 100 times higher than H_2, O_2, and CO_2. The addition of organic vapors produces extinction. Each α particle produces in argon about 1000 quanta of observable light with a wave length between 3000 and 4000 Å. The irradiated energy is almost 1/1000 of the energy transmitted to the gas by the α particle in the form of excitation energy. (J.S.R.)

7963 (FTD-TT-61-111) EXPERIMENTAL DETERMINATION OF THE EFFECTIVE COEFFICIENT OF HEAT CONDUCTIVITY AND DIFFUSION FOR BODIES WITH CHANNEL POROSITY, USING THE METHOD OF ELECTRICAL ANALOGY. G. E. (Ye.) Morozov. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 2, 103-5(1961). 5p.

An analysis is made of the feasibility of substituting electrical measurements for the thermal and diffusion measurements when calculating the thermal characteristics of systems having directional channel porosity. The method devised may be of use in determining the effective coefficient of heat conductivity or the effective coefficient of diffusion in bodies with channels having different shapes and different positions relative to one another. (B.O.G.)

7964 (FTD-TT-61-228) APPLIED MATHEMATICS AND MECHANICS (SELECTED ARTICLES). Translation of Priklad. Mat. i Mekhan., 24: 845-50; 965-8(1961). 20p.

Included are two papers translated from Applied Mathematics and Mechanics, a USSR publication, concerned with the use of crossed magnetic fields for accelerating a conducting fluid, and the solution of boundary-value problems of magnetohydrodynamics. Separate abstracts were prepared for the two papers. (B.O.G.)

7965 (FTD-TT-61-228(p.1-11)) CERTAIN POSSIBILITIES OF ACCELERATING A CONDUCTING FLUID USING CROSSED MAGNETIC FIELDS. I. B. Chekmarev and Ya. S. Uflyand. Translated from Priklad. Mat. i Mekhan., 24: 845-50(1961).

The nonsteady-state flow of a viscous incompressible conducting medium was examined in a flat channel located in a transverse uniform magnetic field, in which motion occurs as a result of the penetration of a variable longitudinal magnetic field from the walls into the fluid. A study of the transition regime of an analogous problem for an inviscid fluid is described. The acceleration of an inviscid conducting fluid in an annular channel is discussed. Results are given only for the limiting regime of uniform motion. (B.O.G.)

7966 (FTD-TT-61-228(p.12-20)) SOLUTION OF CERTAIN BOUNDARY-VALUE PROBLEMS OF MAGNETOHYDRODYNAMICS. A. B. Vatazhin. Translated from Priklad. Mat. i Mekhan., 24: 965-8(1961).

An examination is made of problems dealing with the flow of electrically conducting media in flat channels with various boundary conditions in the presence of a magnetic field. For a channel in which the walls of the central section are electrodes and the remaining sections are insulators, solutions are obtained for the case of a constant magnetic field and an arbitrary law of the variation of velocity across the channel and for the case of a constant flow velocity and a magnetic field arbitrary along the length of the electrodes. (B.O.G.)

7967 (JPRS-10223) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, MINISTRY OF HIGHER EDUCATION, RADIOPHYSICS SERIES. Translation of Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: No. 2, 203-381 (1961). 294p.

Nineteen papers are included concerned with topics in radiophysics. Separate abstracts have been prepared for two papers. (B.O.G.)

7968 (JPRS-10223(p.83-91)) ON THE INCOHERENT RADIO EMISSION OF THE CHARGED PARTICLES MOVING IN THE EARTH'S MAGNETIC FIELD. E. (Ye.) A. Benediktov and V. Ya. Eidman (Eydman). (Translation).

An examination is made of the incoherent radio emission of fast charged particles in the Earth's ionosphere taking into account its magnetic field. Quantitative estimations are given of the intensity of the radiation in the medium-frequency band. (auth)

7969 (JPRS-10223(p.167-71)) ON THE INFLUENCE OF A FREQUENCY CHANGE ON THE OUTPUT ENERGY IN A LINEAR ELECTRON ACCELERATOR. A. V. Shalnov and N. M. Gavrilov. (Translation).

An equation is obtained which allows the evaluation of the influence of input frequency changes on the output energy in the section of a linear electron accelerator when a phase wave velocity equals that of light. The current load of the accelerated particles is considered. (auth)

7970 (JPRS-11630) EVALUATION OF r_{ik}-INTEGRALS USED DURING CALCULATIONS OF THE GROUND STATE OF LITHIUM. H. Aden. Translated from Ann. Physik (7), 8: 28-30(1961). 4p.

Integrals occurring in computations involving 3-electron atoms or ions are discussed, and numerical values for these integrals are tabulated. (auth)

7971 (KFK-tr-57) DIE BILDUNG NEGATIVER IONEN BEI ATOMSTÖSSEN. (Formation of Negative Ions by Atomic Collisions). Ya. (Ja.) M. Fogel. Translated into German by Leo Klasinc (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Ger.) from Uspekhi Fiz. Nauk, 71: 243-87(June 1960). 81p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 23440.

7972 ENERGY DISTRIBUTION OF SECONDARY ELECTRONS FROM COPPER–BERYLLIUM ALLOY BY POSITIVE IONS OF INERT GASES. I. ELECTRO-POLISHED SURFACE. Toshio Sugiura (Univ. of Osaka Prefecture). Bull. Chem. Soc. Japan, 34: 1475-81(Oct. 1961). (In English)

The distribution curves of the kinetic energies of the secondary electrons from an electropolished copper-beryllium surface bombarded by inert gas ions were measured by the retarding potential method together with the yield of the secondary electron emission. The contact potential difference between the ion target (electropolished copper-beryllium) and the electron collector (gold) was also measured by the retarding potential method for the thermal electrons from tungsten, and the correction of this contact potential difference was made for the kinetic energies of secondary electrons. The contact potential difference between gold and electro-polished copper-beryllium (4%) is 0.95 ev. The results of the energy distribution curves of secondary electrons indicate that the yield of secondary electrons is increased by increasing the kinetic energy of the primary ions, and that this increment in the yield is mainly contributed from the secondary electrons which have lower kinetic energies than that of the secondary electrons emitted by incident ions of low kinetic energies. The total number of emitted electrons is increased with the increase in the value of the ionization potential of incident ions, and the kinetic energies of emitted electrons become greater by increasing the potential energy of incident ions. In contrast with the singly-charged ions, the doubly-charged ions give rise to the broadening of the energy distribution curves. (auth)

7973 MAGNETOHYDRODYNAMICS. Osman K. Mawardi (Massachusetts Inst. of Tech., Cambridge). Ciencia y tec. (Buenos Aires), 129: 136-46(May-June 1960). (In Spanish)

The continuum point of view is emphasized. Subjects included the governing equations for the motion of the fluid, waves of small amplitude, magnetohydrostatics, instability, and shock theory. (auth)

7974 PARENT-ION RECAPTURE IN GASES. S. G. ElKomoss and J. L. Magee (Univ. of Notre Dame, Ind.). J. Chem. Phys., 36: 256-62(Jan. 1962).

The mechanism of parent-ion recapture of electrons in gases is considered in some detail. Two models are used: one applicable at low and intermediate pressures and the other applicable at high pressures. It appears that essentially all preferential recombination can be explained satisfactorily in terms of parent-ion recapture of electrons. A brief consideration of solids is also given and it is shown that parent-ion recapture is to be expected in irradiated semi-conductors which have small mobility of charge carriers. (auth)

7975 SHOCK TUBE DETERMINATION OF DISSOCIATION RATES OF HYDROGEN. John P. Rink (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 36: 262-5(Jan. 1962).

The rate of dissociation of hydrogen was determined in noble gas–H_2 mixtures over the temperature range 2800 to 5000°K by density measurements in incident shock waves. An x-ray densitometer was used to measure the density profile produced by the shock wave and the dissociation process. The experimental density profiles were compared with calculated profiles which extended from the shock to the equilibrium region to determine the dissociation rates. The three reactions considered were $H_2 + M \underset{k_r}{\overset{k_d}{\rightleftharpoons}} 2H + M$, where M can be Xe, H_2, and H. The values and error limits of $k_r = k_d/K$ for these third bodies in cc^2 $mole^{-2}$ sec^{-1} are $1.5 \times 10^{18} T^{-1} \pm 30\%$, $3 \times 10^{18} T^{-1} \pm 50\%$, and $1 \times 10^{19} T^{-1} \pm 50\%$, respectively. The third body efficiencies of H_2 and H relative to Xe are 2 and 7. Kr and Ar were found to have the same efficiency as Xe in the hydrogen dissociation process. The temperature dependence of the recombination coefficient could not be determined in these measurements, so the T^{-1} was arbitrarily selected for all species. These rate coefficients are approximately a factor of 2 larger than the corresponding numbers for oxygen. (auth)

7976 CALCULATION OF ELECTRON-COUPLED NUCLEAR SPIN-SPIN INTERACTIONS IN MOLECULES BY A VARIATIONAL PROCEDURE. D. E. O'Reilly (Argonne National Lab., Ill.). J. Chem. Phys., 36: 274-80(Jan. 1962).

By means of a variational procedure, spin-spin coupling constants between nuclei in molecules are evaluated. The Hamiltonian is divided into a part depending on electron spin operators and a part involving only electron orbital angular momenta. A variational function for the first part is constructed by expansion of the wave function in terms of electron spin operators, the first two terms of which are the electron spin densities at the nuclei of interest and succeeding terms contain electric moments of the unperturbed electronic charge distribution of the ground state of the molecule. Retaining terms up to and including the electric dipole moment, a two parameter variational function is used for minimization and an expression for the coupling constant is derived. This result is applied to the hydrogen molecule using valence bond, molecular orbital, and James-Coolidge type wave functions. C^{13}, N^{14}, O^{17}, and F^{19} coupling constants with protons in CH_4, NH_4^+, H_2O, and HF, respectively, are computed with valence bond and molecular orbital functions. The relation of these results to the conventional perturbation theory approach is discussed, particularly in regard to effective average energy denominators which can be computed by the present procedure. A variational method for electron orbital contributions is briefly considered as well as the calculation of long range coupling constants. (auth)

7977 LUMINESCENCE OF COPPER-ACTIVATED ORTHOPHOSPHATES OF THE TYPE $ABPO_4$ (A = Ca, Sr,

OR Ba AND B = Li, Na, OR K). W. L. Wanmaker and H. L. Spier (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). J. Electrochem. Soc., 109: 109-14(Feb. 1962).

Activation of orthophosphates of the type $ABPO_4$ with copper gives an efficient phosphor in some cases. The brightest phosphors found are $SrLiPO_4$–Cu and $BaLiPO_4$–Cu, with an emission peak (with 2537 Å excitation) at 4150 and 4600 Å, respectively. The properties of orthophosphates of the type $ABPO_4$ with two kinds of alkali earth or alkali metal ions, respectively, were also studied. X-ray diagrams of the compounds investigated are given. (auth)

7978 WEST-EAST MOTION OF AN AURORAL-ZONE X-RAY EVENT. R. R. Brown (Univ. of California, Berkeley). J. Geophys. Research., 67: 31-5(Jan. 1962).

A west-east motion of an auroral-zone x-ray event was observed late in the magnetic storm of June 22-23, 1961. Time delays between x-ray bursts at balloon altitude and increases in ionospheric absorption of cosmic radio noise indicate that velocity components along the auroral zone of 200-300 m/sec are present. (auth)

7979 IRREGULAR LUNAR REFLECTION POLARIZATION CHANGES NOTED IN THE PRESENCE OF AURORA. J. Klobuchar, J. Aarons, H. Whitney, and G. Kantor (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Research, 67: 111-13(Jan. 1962).

Bistatic lunar reflection of 99.4-Mc signals was used to determine the total integrated ionospheric electron density. On November 13, 1960, fast, irregular changes in the received signal polarization occurred during the time that a visible aurora was observed along one leg of the bistatic path. After sunrise on the same day slow, regular Faraday polarization rotation was observed. It is suggested that the ordinary and extraordinary ray components that travel along slightly different paths may have encountered small, high-velocity ionospheric irregularities, thus producing unusual signal phase changes. (auth)

7980 ATTENUATION OF MEDIUM-FREQUENCY SKY-WAVE SIGNALS IN AUSTRALIA FOLLOWING THE MID-PACIFIC HIGH-ALTITUDE NUCLEAR EXPLOSIONS IN AUGUST 1958. J. M. Dixon (Australian Broadcasting Control Board, Melbourne). J. Geophys. Research, 67: 123-5(Jan. 1962).

Similar attenuation patterns are found in quasi-maximum medium-frequency sky-wave field-strength values following each of the high-altitude nuclear explosions at Johnston Island. The pattern is formed by periods of severe attenuation lasting 1 or 2 days; it extends from the second to the tenth day after each explosion. (auth)

7981 ELECTRON TEMPERATURE EVIDENCE FOR NONTHERMAL EQUILIBRIUM IN THE IONOSPHERE. N. W. Spencer, L. H. Brace, and G. R. Carignan (Univ. of Michigan, Ann Arbor). J. Geophys. Research, 67: 157-75(Jan. 1962).

A review of the 'dumbbell' electrostatic probe experiment is given. The electron temperature and positive ion density data resulting from its use in two flights at Fort Churchill, Canada, and in two flights at Wallops Island in midsummer 1960 and spring 1961, are discussed. The electron temperature profiles exhibit large positive gradients between 150 and 250 km, gradually changing to an approximately isothermal region (approximately 2800°K) above 250 km. An exception to this was the second Wallops Island measurement in which a negative temperature gradient was observed above 250 km, in a quiet ionosphere. The ion density profiles show only slight density maxima in the E region, the less distinct F_1 regions, and, at Wallops Island, well defined F_2 maxima at about 300 kilometers. Electron density data from two-frequency beacon experiments flown on the same rockets, and simultaneously recorded ionograms are presented for comparison. Agreement is obtained between the electron density measured by the two different techniques and the ion density as measured by the dumbbell technique. It is concluded that the dumbbell experiment measures temperatures representative of all thermal electrons. If gas temperatures derived from satellite drag measurements and other techniques are valid as generally accepted, electrons and neutral particles are not in thermal equilibrium in the daytime ionosphere to altitudes of at least 420 km. Electron temperature varies significantly with the state of the ionosphere, electron temperatures being higher and more variable in the more disturbed ionospheres. (auth)

7982 UPPER-ATMOSPHERE HELIUM IONS. W. B. Hanson (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Research, 67: 183-8(Jan. 1962).

An experimental measurement of the ion concentration in the upper ionosphere is examined in light of a suggestion that helium is an important constituent of the high atmosphere. An isothermal region of helium ions at 1600°K is found above approximately 1200 km. Consideration of the loss mechanism for helium ions by ion-atom interchange with nitrogen molecules indicates that the helium ions are removed in the neighborhood of 370 km and that the rate constant for the ion-atom interchange process is of the order of 10^{-12} cm^3 sec^{-1}. It is concluded that a layer of helium ions at least 2000 km thick (the heliosphere) separates the ionosphere from the protonosphere. (auth)

7983 ISOTOPIC COMPOSITION OF BARIUM AND CERIUM IN STONE METEORITES. Shunji Umemoto (Univ. of California, San Diego and La Jolla). J. Geophys. Research, 67: 375-9(Jan. 1962).

Measurements were performed on the relative abundances of the isotopes of barium from terrestrial samples and from three meteorites. It is found that the abundances in the three meteorites deviate from those of terrestrial barium by approximately equal amounts. The meteorites contain more of the low mass isotopes relative to the highest mass isotope than do the terrestrial samples and the variation is approximately linear with mass. (auth)

7984 ARGUS RADAR RETURNS IN CONJUGATE AREA. Philip Newman (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Research, 67: 407-8(Jan. 1962).

Data from Argus tests are analyzed. The concept of orthogonal reflection from aurora and field-aligned ionization is utilized. Satisfactory consistency is obtained. (L.N.N.)

7985 CORRELATION OF THE RELATIVE PULSE HEIGHT OF ORGANIC SCINTILLATORS WITH POLARITY AND RESONANCE EFFECTS. Stanley R. Sandler, Paul J. McGonigal, and K. C. Tsou (Borden Cehmical Co., Philadelphia). J. Phys. Chem., 66: 166-71(Jan. 1962).

A linear correlation was found between relative pulse height of plastic scintillators and the ionization potential and Hammett or Taft substituent constants (σ and σ_I, respectively) of the solvent and fluor that were used in the study. Some aspects of the scintillation mechanism are discussed. (auth)

7986 STUDY OF THE HELICOIDAL ANTIFERROMAGNETISM OF $MnAu_2$ BY NEUTRON DIFFRACTION. André Herpin and Pierre Meriel (Centre d'Etudes

Nucléaires, Saclay, France). J. phys. radium, 22: 337-48(June 1961). (CEA-1801). (In French)

A study by neutron diffraction showed that the tetragonal centered structure of $MnAu_2$ can be considered as a packing normal to the c axis of sheets of manganese separated by two sheets of gold. Moreover $MnAu_2$ is a helimagnetic: all atoms of manganese of the same sheet have their moments parallel between themselves and normal to the c axis, these moments turning by a constant angle when passing from one sheet to the next one. A field parallel to c has little influence on this magnetic structure. On the other hand a field normal to c modifies abruptly this structure as soon as it goes beyond a threshold of 9.6 k gauss. A theory, where one takes into account exchange interactions between atoms of first and second neighboring layers, quantitatively accounts for all the properties of this alloy which were observed. (auth)

7987 DEPENDENCE OF RADIOLUMINESCENCE YIELD ON THE METHOD OF POLYMERIZATION IN PLASTIC SCINTILLATORS. Zenon Polacki (Technical Univ., Danzig). Nukleonika, 6: 643-8(1961). (In Polish)

Relative yields of photo- and radioluminescence were measured in plastic scintillators (polystyrene + p-terphenyl + POPOP and polystyrene + anthracene). The dependence on concentration of benzoyl peroxide (at 70°C), on polymerization temperature (without a catalyst), and on average molecular weight of solvent (polystyrene) was established. Some increase of radioluminescence yield was noted when adding small amounts of benzoyl peroxide. Considerable increase was observed when solvent average molecular weight was also increased. (auth)

7988 STATIC GRAVITATIONAL FIELDS IN GENERAL RELATIVITY. A. A. Evett (Univ. of Arizona, Tucson). Nuovo cimento (10), 22: 779-83(Nov. 16, 1961). (In English)

Static gravitational fields are defined in terms of the existence of a set of observers mutually at rest with respect to each observer's Fermi coordinate frame. The Fermi co-ordinate frame is chosen because it is the only non-rotating frame for an observer. It is shown that this definition is equivalent to the usual one, and the time-reversibility of static fields is derived. Application of Fermi cylindrical co-ordinates to an axially symmetric static field is discussed. (auth)

7989 TESTING TIME AND CONTACT-ZONE PHENOMENA IN SHOCK-TUBE FLOWS. William J. Hooker (General Electric Research Lab., Schenectady, N. Y.). Phys. Fluids, 4: 1451-63(Dec. 1961).

Measurements are made in a shock tube of the hot-flow duration, the structure of the contact front, and the nature of the mixing zone. The flow duration is obtained by spectroscopically detecting the first arrival of the driver gas, and is observed to become vanishingly small with decreasing initial driven gas pressure. The data are compared with predictions of laminar theory and the numerical example of turbulent theory. Agreement with the one turbulent-theory point is good, while the agreement with laminar theory is not as close. Approximations in laminar theory, which contribute to the lack of correlation with the data obtained in the smaller diameter shock tubes, are emphasized. A formulation of the flow model is developed that predicts closely the actual shock-tube flow durations. (auth)

7990 EFFECT OF BOUNDARY-LAYER GROWTH IN A SHOCK TUBE ON SHOCK REFLECTION FROM A CLOSED END. George Rudinger (Cornell Aeronautical Lab., Inc., Buffalo). Phys. Fluids, 4: 1463-73(Dec. 1961).

The pressure behind a shock wave propagating in a constant-area duct increases slightly with time as a result of the growing boundary layer. This rise is considerably magnified by the shock reflection from the closed end of the duct. Analysis of the local interaction of the reflected shock with the boundary layer yields information on the shock configuration, but the combined effects of the waves produced by the growing boundary layer along the entire shock tube must be considered to obtain the state of the gas behind the reflected shock. The theory of the flow field behind the incident shock is modified to allow for effects, in addition to boundary-layer growth, which cause deviations from an ideal shock-tube flow. Experimental observations of the pressure rise behind the reflected shock, obtained for shock pressure ratios up to about 4.5, are in satisfactory agreement with the computed results, and estimates for stronger shock waves are presented. (auth)

7991 VISCOUS FLOW THROUGH POROUS MEDIA. Stephen Prager (Univ. of Minnesota, Minneapolis). Phys. Fluids, 4: 1477-82(Dec. 1961).

The resistance of a porous medium to a fluid streaming through it is estimated by minimizing the rate of energy dissipation for a class of trial stress distributions. Rigorously valid lower bounds on the resistance are obtained in terms of certain two- and three-point averages characterizing the medium. Results are given for flow both with and without slip at the pore walls. (auth)

7992 CONDUCTIVITY OF SLIGHTLY IONIZED GASES. Leonard S. Taylor (General Electric Co., Valley Forge, Penna.). Phys. Fluids, 4: 1499-1503(Dec. 1961).

A kinetic theory of the conductivity of a slightly ionized gas is developed to distinguish between alternate expressions derived from the Boltzmann transport equation. It is determined that the current in a Lorentzian model is obtained by averaging the electron drift velocity over a function resembling the zero field distribution shifted by the drift velocity. The linear term corresponds to one of the proposed expressions. Nonlinear terms may also be obtained. The quadrature current is increased by a factor proportional to the ratio of the average electron kinetic energy in the field to the kinetic energy in the absence of the field when the first nonlinear term is included. (auth)

7993 KIRKENDALL EFFECT IN GASEOUS DIFFUSION. II. ABSOLUTE DETERMINATION OF DIFFUSION COEFFICIENTS. E. A. Mason (Univ. of Maryland, College Park). Phys. Fluids, 4: 1504-5(Dec. 1961).

It is shown how the Kirkendall effect in gaseous diffusion can be used to determine absolute values of diffusion coefficients, rather than only relative values, by extrapolation of the observed marker motion to zero capillary diameter. In this way the diffusion coefficient of He–Ar at 30°C and 1 atm is found to be 0.761 cm^2/sec, in agreement with a directly measured value of 0.762 cm^2/sec. (auth)

7994 ALFVÉN WAVES IN SOLID-STATE PLASMAS. S. J. Buchsbaum and J. K. Galt (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Fluids, 4: 1514-16(Dec. 1961).

Alfvén waves can be studied experimentally in certain solid-state plasmas with greater facility than in gaseous plasmas. This results from the fact that in these solid-state plasmas all the charge carriers have masses equal to or less than the free electron mass. Alfvén waves can thus be studied at microwave frequencies. Experimental results on microwave absorption in bismuth are interpreted in terms of the properties of Alfvén waves. (auth)

7995 SOURCE AND REFLECTION PROBLEMS IN MAGNETO-IONIC MEDIA. William C. Meecham (Space

Tech. Labs., Inc., Los Angeles and Univ. of Minnesota, Minneapolis). Phys. Fluids, 4: 1517-24(Dec. 1961).

The scattering problems involving electromagnetic radiation propagating in magneto-ionic media are formulated. Because of the magnetic field the medium becomes anisotropic. A practical case of interest is that in which the frequency of the radiation is very low, in the audio range. A Green's formula is derived that expresses the field in interior regions in terms of the value of the field on any scattering surfaces present and shows the effect of sources. The Green's formula involves the Green's function in the usual way. The Green's function is obtained using a representation in terms of the eigenmodes for electromagnetic radiation propagating in the medium. The Green's function is evaluated for the special case of very low frequency. (auth)

7996 HIGH-VOLTAGE GLOW DISCHARGES IN D_2 GAS. II. CATHODE FALL THEORY. G. W. McClure and K. D. Granzow (Sandia Corp., Albuquerque, N. Mex.). Phys. Rev., 125: 3-10(Jan. 1, 1962).

A one-dimensional theoretical treatment of the cathode fall region of 40 to 100-kv glow discharges in D_2 gas is presented. The region is assumed to be fed with an external supply of slow D_2^+ ions from an adjoining plasma at one boundary and an influx of secondary electrons from a cathode forming a second boundary. As a function of the current density of plasma ions the following quantities are calculated: the energy distributions and fluxes of D^+, D_2^+, and D particles incident on the cathode, the cathode electron current, the thickness of the cathode fall region, the ratio of cathode fall electron current to plasma ion current, the potential distribution including the effect of positive-ion space charge, and the voltage vs current characteristics for a fixed cathode fall thickness. The theoretical results are compared with experimental results. Using the available cross-section data, account is taken of D_2^+ charge exchange and dissociation, electron capture by D^+, electron loss from D, ionization of the gas by fast D^+, D_2^+, and D, and ionization by cathode secondaries. Arbitrary approximations are made to a few of the unknown cross sections. (auth)

7997 EFFECT OF DISLOCATIONS ON SELF-DIFFUSION IN GERMANIUM. Hans Widmer (Columbia Univ., New York). Phys. Rev., 125: 30-2(Jan. 1, 1962).

The effect of dislocations on the rate of diffusion of radioactive Ge^{71} in intrinsic germanium single crystals was studied at temperatures near 740°C. The dislocations were introduced by either distorting the surface by lapping under pressure, thus producing a network of dislocations; or bending the specimens so as to introduce up to 2×10^6 parallel edge dislocations per cm^2. Both deformation treatments produce an enhancement of self-diffusion relative to that in undeformed crystals. In both cases the diffusion can be described in terms of an enhanced volume diffusion with apparent diffusion coefficients up to 38% larger than the value for undeformed intrinsic specimens. (auth)

7998 RESONANCE IN PHONON-PHONON SCATTERING. P. Carruthers (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 125: 123-5(Jan. 1, 1962).

The scattering process, two phonons → two phonons, is examined in perturbation theory. One of the contributions of second order in the cubic anharmonic potential gives rise to an energy denominator that can vanish. This difficulty is removed by noting that the intermediate phonon has a complex self-energy associated with its instability in the presence of anharmonic forces. Approximating the irreducible self-energy by its lowest-order contribution, one finds a Breit-Wigner form of width equal to the decay rate, one phonon → 2 phonons, calculated to lowest order. An experiment is proposed to observe directly the predicted resonance. (auth)

7999 APPLICATION OF A DISPERSION RELATION TO THE ELECTRON IMPACT WIDTHS AND SHIFTS OF ISOLATED SPECTRAL LINES FROM NEUTRAL ATOMS. H. R. Griem (Univ. of Maryland, College Park and U. S. Naval Research Lab., Washington, D. C.) and C. S. Shen. Phys. Rev., 125: 196-9(Jan. 1, 1962).

From a quantum mechanical dispersion relation for the scattering amplitudes of thermal electrons on excited states of emitting atoms follows a dispersion relation between electron impact widths and shifts of isolated spectral lines. This relation is used to check the consistency of previous calculations of the impact broadening made with the classical path assumption and to fully determine the parameters for the cutoff at small impact parameters in the usual perturbation theory. (auth)

8000 PLASMA THEORY OF THE MANY-ELECTRON ATOM. Paul H. Levine (California Inst. of Tech., Pasadena) and Oldwig von Roos. Phys. Rev., 125: 207-13 (Jan. 1, 1962).

A new approach to the many-electron atom, based on the formal equivalence between the Hartree-Fock equations and a quantum-mechanical generalization of the collisionless Boltzmann (Vlasov) equation, is presented. This equivalence casts the problem into the framework of conventional plasma theory, the Vlasov equation being merely replaced by its quantum-mechanical analog. The quantum Vlasov equation permits a straightforward expansion of the quantum-mechanical phase space distribution function in powers of $\hbar$. The first step of this expansion, corresponding physically to a classical correlationless plasma obeying Fermi statistics, leads to the Thomas-Fermi model. Successive steps generate quantum and exchange corrections. The method is applied to the case of the "statistical" correlationless atom (or ion), generalized for the first time to arbitrary temperature and nonzero total orbital angular momentum, with quantum and exchange effects being included to order $\hbar^2$. (auth)

8001 VIBRATIONAL EXCITATION OF NITROGEN BY ELECTRON IMPACT. G. J. Schulz (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 125: 229-32(Jan. 1, 1962).

The vibrational excitation of nitrogen molecules by electrons in the energy range 1.5 to 4 ev is studied using a double electrostatic analyzer. The beam of essentially monoenergetic electrons (half-width about 0.06 ev) is produced by the first analyzer and is crossed by a molecular beam of N_2 in the collision chamber. The energy distribution of forward scattered electrons is analyzed in the second electrostatic analyzer. Peaks resulting from those electrons losing discrete amounts of energy in exciting vibrational levels up to $v = 8$ are observed. The energy dependence of the cross section for vibrational excitation to $v = 2, 3, 4, 5, 6, 7, 8$ is obtained and pronounced structure is observed. The experiment is consistent with the hypothesis that the vibrational excitation in N_2 around 2.3 ev proceeds via a temporary negative ion. (auth)

8002 MACH'S PRINCIPLE AND THE LOCALLY MEASURED GRAVITATIONAL CONSTANT IN GENERAL RELATIVITY. Carl H. Brans (Princeton Univ., N. J.). Phys. Rev., 125: 388-96(Jan. 1, 1962).

It is conjectured that a "Mach's principle" might lead to a dependence of the local Newtonian gravitational constant, K, on universe structure, $K^{-1} \sim M/R$. Einstein and others

have suggested that general relativity predicts such a result. A closer analysis, however, including the carrying out of the geodesic equations to second order, seems to indicate that this is not true and that the apparent "Mach's principle" terms involving total universe structure are really only coordinate effects. Further, the measure of gravitating mass obtained in a local, proper Newtonian gravitational experiment is compared in a coordinate-free way to an experimentally measurable inertial mass and found to be related to it in a way independent of the rest of the universe. A generalization of these results is given. It is based on the fact that in general relativity the only way the universe can influence experiments done in an electrically shielded laboratory is through the metric and that this can be "transformed away" to any degree of accuracy for a sufficiently small laboratory. Consequences of this are summarized in Dicke's "strong principle of equivalence." It is noted, however, that there are other statements which might be called "Mach's principles" which are satisfied in general relativity. (auth)

8003 DIFFERENTIAL ENERGY LOSS AND RANGES OF Ne, N AND He IONS. D. I. Porat and K. Ramavataram (The University, Manchester, Eng.). Proc. Phys. Soc. (London), 78: 1135-43(Dec. 1, 1961).

The rate of energy loss for Ne^{20} and N^{14} ions at 0.4 to about 6 Mev was measured in C, Al, Ni, Ag, and Au. The ranges of the ions were calculated by integrating the differential energy loss, taking into account scattering and energy losses due to nuclear collisions. The rate of energy loss for He^4 ions at up to 2-Mev kinetic energy is reported, and range curves in Al, Ni, Ag, and Au at up to 3 Mev are presented. Results on the deuteron energy loss in Ag are used to extend data for protons to lower energies. The relative accuracy of the stopping power data is to about 1% and the absolute accuracy to better than 5%. (auth)

8004 THE LUMINESCENCE OF CsBr(Tl) AND CsI(Tl) AS A FUNCTION OF TEMPERATURE. J. C. Robertson, J. G. Lynch, and W. Jack (Univ. of Glasgow). Proc. Phys. Soc. (London), 78: 1188-94(Dec. 1, 1961).

The luminescent efficiencies and decay times of CsBr(Tl) and CsI(Tl) were studied as a function of temperature in the range -150 to 150°C. Protons at 14 Mev, and alpha particles at 5.3 Mev were used as the exciting radiation. In general, at any one temperature, the luminescence appears to consist of the sum of a fast and a slow exponential component. It is shown that for optimum particle discrimination by pulse shape analysis, there is no advantage to be obtained by maintaining the crystal of CsI(Tl) or CsBr(Tl) at temperatures other than room temperature. Activation energies for electron traps in the crystal corresponding to the decay time components τ_i were obtained. (auth)

8005 A SEARCH FOR VIBRATIONAL ENERGY EFFECTS IN THE DISSOCIATION OF H_2^+ IONS BY HYDROGEN GAS. A. C. Riviere and D. R. Sweetman (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 78: 1215-17(Dec. 1, 1961).

The dissociation cross section on interaction with hydrogen gas was measured for H_2^+ ions at 280 to 670 kev and with high and low vibrational excitation. An increase of $7 \pm 4\%$ was found for the cross section for simple dissociation in the case of the more highly vibrationally-excited ions. For dissociation into two protons, the difference between the cross sections was less. (auth)

8006 LOW TEMPERATURE CLOUD CHAMBER STUDIES ON WATER VAPOUR. L. A. Madonna (Univ. of Ottawa), C. M. Sciulli, L. N. Canjar, and G. M. Pound. Proc. Phys. Soc. (London), 78: 1218-22(Dec. 1, 1961).

Critical supersaturation for precipitation of water droplets or ice crystals from the vapor was measured between 0 and -75°C by an expansion-chamber technique. Nitrogen was used as the carrier gas, and measurements were made both in the presence and absence of an electric field. The temperature dependence of critical supersaturation was th same in both situations. Thus existing critical supersatura tion data for nucleation of water droplets from the vapor in the presence of an electric field probably represent heterogeneous nucleation on ions. Comparison of the data taken in the presence of a field with the Becker-Döring equation for homogeneous nucleation shows fair agreement at higher but marked negative deviation at lower temperatures. The precipitate particles appeared to be spherical above -65°C, while at lower temperatures, precipitation was in the form of ideomorphic ice crystals. (auth)

8007 VACUUM ULTRA-VIOLET SPECTRA OF MULTIPLY IONIZED INERT GASES. B. C Fawcett, B. B. Jones, and R. Wilson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 78: 1223-6(Dec. 1, 1961).

The high-temperature plasma ($kT_e \simeq 20$ ev) produced in Zeta is a copious source of spectral lines emitted by highly-ionized atoms in the vacuum ultraviolet. Spectroscopic investigations in the wavelength range 400 to 1000 Å reveal new lines due to multi-ionized Ne, A, Kr, and Xe. Identification is based on the successive appearance of the ionization states of each element, supplemented by isoelectronic calculations that allowed transitions to be assigned to most lines. (auth)

8008 THE EFFECT OF PARTICLE STREAMS ON TRANSVERSE HYDROMAGNETIC WAVES. E. R. Harrison (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 78: 1236-43(Dec. 1, 1961).

A magnetic field is "frozen" into a moving conducting fluid when certain conditions are fulfilled, as for example, when the frequency of the fluid disturbance is small compared with the cyclotron frequencies of the fluid particles. If the fluid contains streams of moving particles, parallel to the magnetic field, the magnetic field is also "frozen" into the streams when there are transverse perturbations. The condition is that the Doppler-shifted frequency of the disturbance must be small compared with the cyclotron frequency of the stream particles. It follows that the phase velocity of transverse hydromagnetic waves is modified if such streams are present. In effect, the momentum flux of the streams reduces the "tension" of the magnetic flux lines. When the kinetic energy density relative to the center-of-mass system exceeds the magnetic energy density, the phase velocity in an infinite medium has complex conjugate values, and the hydromagnetic wave grows in amplitude. In the case of a stream of finite radius, the phase velocity shows dispersion for wavelengths greater than the stream radius and there is an increase in the domain of stability. (auth)

8009 THE MAGNETIC SUSCEPTIBILITY OF AN ELECTRON GAS. M. J. Stephen (Oxford Univ.). Proc. Roy. Soc. (London), A265: 215-28(Jan. 23, 1962).

The cluster expansion of the quantum-mechanical grand partition function is obtained for a gas of interacting charged particles in a uniform magnetic field. The magnetic field is included by using a Green function for a charged particle in a uniform field. The theory is applied to calculate the magnetic susceptibility of an electron gas for small magnetic fields. For Boltzmann statistics, the

equation of state is unaltered to the Debye-Hückel approximation, and the field only enters into the quantum-mechanical corrections to this equation. The first terms in a low-density expansion of the susceptibility are obtained. For Fermi-Dirac statistics, an exact high-density expansion of the susceptibility to first order in the coupling constant is obtained at zero temperature. The first-order exchange energy is divergent, but this divergence is removed by including the ring diagrams. (auth)

8010 MAGNETIC ORDERING IN THE RARE-EARTH METALS WITH MORE THAN HALF-FILLED 4f SHELLS. Hirosi Miwa and Kei Yosida (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 26: 693-721(Nov. 1961). (In English)

The effect of the anisotropy energy on the screw spin structure is investigated. Spin structures found in dysprosium, holmium, and erbium are shown to be stable if the anisotropy constants of second, fourth, and sixth orders have appropriate magnitudes and signs. Anisotropy energies decrease with rising temperature at different rates according to their orders. This temperature variation of the anisotropy energy causes the magnetic transitions between different spin structures in these rare-earth metals. It is shown that the state with the oscillation of the z component of the spin observed in the high temperature phase of erbium is always stable just below the Néel temperature when the second-order anisotropy makes the easy axis of the spin parallel to the c axis. The change of the pitch of the screw with temperature due to the quadrupole interaction is also calculated on the basis of the molecular field approximation, and it is shown to be too small compared with the experimental result. (auth)

8011 PERSISTENT RING CURRENTS IN AN IDEAL BOSE GAS. J. M. Blatt (Bell Telephone Labs., Inc., Murray Hill, N. J. and Univ. of New South Wales, Kensington). Progr. Theoret. Phys. (Kyoto), 26: 761-89(Nov. 1961). (In English)

Production and persistence of ring currents are investigated in a simple model consisting of Bose-Einstein particles contained in a ring-shaped volume; the particles do not interact with each other, but with randomly distributed scattering centers, and carry a test charge through which they respond to external fields. Except for the Bose-Einstein statistics, this model is identical with that of Kohn and Luttinger, for which a normal, non-zero resistivity exists. The model gives a qualitatively correct insight into the Meissner effect in actual superconductors, where the "bosons" are attractively correlated electron pairs. The mechanism by which ring currents are generated is elucidated, and these ring currents, within the model are shown to have infinite lifetime. The model has no energy gap; the explanation of persistent ring currents is qualitatively dissimilar to the two-fluid model of Bardeen, in which the energy gap is essential; it is an example of a strictly non-ergodic system, and has interest for the foundations of non-equilibrium statistical mechanics. It is predicted that if the ring is maintained between the poles of the magnet and cooled well below the transition temperature, small ring currents are generated. The effect is to force the flux through the ring very close to an integral number of flux "units." This approximate quantization of flux is destroyed when the ring is moved out of the external field. (auth)

8012 PHONON-PHONON INTERACTION IN LIQUID HELIUM II. Kyozi Kawasaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 793-5(Nov. 1961). (In English)

A theory for determining interactions between excitations in liquid helium (R. P. Feynman, Phys. Rev., 94: 262(1954); R. P. Feynman and M. Cohen, Phys. Rev., 102: 1189(1956)) is used to describe phonon interactions in liquid helium II. (L.N.N.)

8013 SOUND ATTENUATION IN LIQUID HELIUM II AT VERY LOW TEMPERATURES. Kyozi Kawasaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 795-7(Nov. 1961). (In English)

Attenuation at temperatures low enough that rotons can be ignored and the phonon mean free path is much greater than the wavelength of sound, is considered. The attenuation constant resulting from three phonon processes is calculated. A perturbation calculation is performed in which the phonon dispersion spectrum is neglected. Agreement with observed values is obtained below 0.4°K. (L.N.N.)

8014 ON THE ONE-DIMENSIONAL FLOW OF A CONDUCTING GAS IN CROSSED FIELDS. Erling Dahlberg (Royal Inst. of Tech., Stockholm and Swedish State Power Board, Stockholm). Quart. Appl. Math., 19: 177-93(Oct. 1961).

Equations governing quasi-one-dimensional steady flow of a conducting perfect gas in crossed, transverse electric and magnetic fields are treated under assumptions that the electric conductivity is a scalar, that the wall drag is small, and that the magnetic field due to the currents in the gas is negligible. The equations are normalized and different flow situations are illustrated by means of phase diagrams (drawn for a gas of constant specific heats, $\gamma = 1.33$). The possibility of a smooth transition from supersonic to subsonic motion is pointed out and the phenomena of standing shock fronts and choking are surveyed for constant-area, small-friction, power-yielding flow. General remarks are given on the system of non-linear differential equations: $x' = P(x, y)/R(x, y)$; $y' = Q(x, y)/R(x, y)$. (auth)

8015 AN IMPLICIT, NUMERICAL METHOD FOR SOLVING TWO-DIMENSIONAL TIME-DEPENDENT DIFFUSION PROBLEMS. Thomas A. Oliphant (Los Alamos Scientific Lab., N. Mex.). Quart. Appl. Math., 19: 221-9 (Oct. 1961).

An implicit scheme is developed for the numerical solution of two-dimensional, time-dependent diffusion and related problems. A general set of linear, simultaneous equations that may occur in 9- point differencing schemes is solved. The method is applied to both linear and nonlinear problems. Each time step is solved by an iterative procedure, and a convergence condition is derived for the linear case. Satisfactory convergence of the iterations is obtained. The method may be applied to simple, unconditionally stable differencing schemes. Schemes involving more than 9 points can be constructed and the method is in principle generalizable to 3 dimensions. (L.N.N.)

8016 ON "TRANSCRITICAL" AND "HYPERCRITICAL" FLOWS IN MAGNETOGASDYNAMICS. R. Seebas (Cornell Univ., Ithaca, N. Y.). Quart. Appl. Math., 19: 231-7(Oct. 1961).

The existence of smooth flows in transonic, trans-Alfvenic, and hypercritical regimes is determined. The flow behavior in the hypercritical regime is, in general, regular for the case $\gamma = 2$. Phenomena associated with the flow of a highly conducting gas in the presence of a strong aligned magnetic field are exemplified in two simple solutions. (L.N.N.)

8017 SCATTERING OF A COMPRESSIONAL WAVE BY A PROLATE SPHERIOD. Norman G. Einspruch and Carl A. Barlow, Jr. (Texas Instruments Inc., Dallas). Quart. Appl. Math., 19: 253-8(Oct. 1961).

The problem of the scattering of a plane acoustic wave by a soft prolate spheroidal obstacle embedded in a fluid medium is solved. An exact solution is given; approximate solutions, valid in long and short wavelength limits, are presented. The problem of compressional wave scattering by small prolate spheroidal obstacles of arbitrary acoustic properties is solved. Expressions for total scattering cross sections are derived. (L.N.N.)

8018 MHD–TECHNICAL TROIKA TIMED FOR LIFT-OFF. John A. Thornton (Northwestern Univ., [Evanston, Ill.]). Research/Develop., 13: No. 2, 5-9; 12-17(Feb. 1962).

The basic principles, experimental work, applications, and future of magnetohydrodynamics are discussed. The bottleneck at the moment seems to be the development of new high temperature materials. A brief outline is given of its use in the fields of controlled nuclear fusion, power generation, flow measurement, and space propulsion. (N.W.R.)

8019 METHOD OF MEASURING THE NORMAL VELOCITY DISTRIBUTION OF SECONDARY ELECTRONS AT LOW PRIMARY BOMBARDING ENERGIES. V. Evtuhov, G. F. Smith, and L. S. Yaggy (Hughes Aircraft Co., Malibu, Calif.). Rev. Sci. Instr., 32: 1362-6(Dec. 1961).

Experimental apparatus designed to measure the secondary electron emission from solids at low primary electron energies is described. The design permits the determination of the normal velocity distribution of secondary electrons off insulating targets. Some of the difficulties associated with measurements of this kind are avoided by the use of an orthicon-type deflection system to separate beams. Measurements of the secondary emitting properties of molybdenum, some of which are performed under pulse conditions appropriate for insulating targets, are described to demonstrate the performance of the apparatus. (auth)

8020 BEAM HEATING EFFECTS IN GAS TARGETS. L. P. Robertson, B. L. White, and K. L. Erdman (Univ. of British Columbia, Vancouver). Rev. Sci. Instr., 32: 1405 (Dec. 1961).

The pressure required in a gas target, to keep a constant target thickness as the bombarding-particle current varies, is measured for O_2 and D_2 targets and ~900-kev proton beams. These measurements are used to determine the effective target temperature as a function of beam current. (T.F.H.)

8021 STATISTICAL THEORY OF ELECTRON GAS. Tan-chian Liu, Tsung-an Leng, Ch'un Hsein Ch'en, and Shao-hua Pan (Peng) (Academia Sinica, Peking). Wu Li Hsüeh Pao, 15: 664-72(1959).

Thermodynamic properties of an electron gas are considered using the method of the statistical model hamiltonian. Contributions to the thermodynamic functions from the special class of the Feynman diagrams, corresponding to the infrared divergence of higher order (after Gell-Mann and Brueckner), are calculated. The approximation is justified in a strongly degenerate electron gas of high density, and in a classical gas of low density. Also considered is the effect of local inhomogeneities (impurity centers) on the dynamic properties of the system. Physical consequences of the results obtained are discussed. (Referat. Zhur. Fiz., 10: 26212).

8022 LUMINESCENCE CRISTALLINE. (Crystalline Luminescence). D. Curie. Monographies Dunod. Paris, Dunod, 1960. 216p.

The book forms part of a course in solid state physics at the Faculté des Sciences of Paris. In the introduction fluorescence and phosphorescence are described, and the relationship between luminescent lifetime and yield is indicated. The topics discussed include dipolar and quadrupolar radiations with probabilities of emission and adsorption, emission and adsorption spectra in the configuration curve model, experimental determination and use of configuration curves, optical transitions in a photoconductor crystal, luminous centers in phosphorescent sulfides, electron traps, thermal and optical activation of traps, and energy transfers. (J.S.R.)

Cosmic Radiation

8023 (NP-11232) PROCEEDINGS OF THE COSMIC RAY SYMPOSIUM, AHMEDABAD, MARCH 16-19, 1960. (India. Dept. of Atomic Energy. Cosmic Ray Research Committee, Bombay). 447p.

Sixty-two papers are included on various aspects of cosmic rays, such as time variations, solar and terrestrial relationships, origin, extensive air showers, and high energy nuclear interactions. Separate abstracts were prepared for 56 papers; 2 papers on the lifetime of hyperfragments and a Forbush type decrease in the intensity of heavy nuclei of the primary cosmic radiation were previously abstracted; 4 brief abstracts on daily variation of meson intensity at Gulmarg, long term changes of the daily variation of cosmic rays around the period of minimum solar activity, cosmic ray decreases and the associated magnetic storms, and the physics of fundamental particles are not included in NSA. (P.C.H.)

8024 (NP-11232(p.1-17)) ORIGINS OF COSMIC RAYS. P. Morrison (Cornell Univ., Ithaca, N. Y.).

The main physical phenomena which take place and govern the production and propagation of cosmic rays are outlined. The cosmic ray origin is reduced from a striking and novel process to a natural part of the evolution of stars and of galaxies. Three sources of cosmic radiation are discussed. It is theorized that the higher the particle energy, the larger the volume occupied by such particles. But with the large volume goes the power law decrease of flux density, so that the total energy stored in the particles of each energy region remains at the most constant for the three groups described. Although the theory seems natural, it is felt that it leaves the power-law energy spectrum rather poorly explained. A brief discussion is given on the energy spectrum. (P.C.H.)

8025 (NP-11232(p.18-25)) THE FLUX OF HEAVY NUCLEI ($Z \geq 10$) OF THE PRIMARY COSMIC RADIATION AT THE TOP OF THE EARTH'S ATMOSPHERE. R. R. Daniel and N. Durga Prasad (Tata Inst. of Fundamental Research, Bombay).

An area of 77.8 cm^2 was scanned in Texas on February 6, 1956. A total of 218 S-particles were obtained in the zenith angle interval 66 to 80°, corresponding to an amount of air traversed of 17.4 to 40.0 gm/cm^2. The number of medium and heavy nuclei obtained were 141 and 77, respectively. The value of M/H was derived after correcting for scanning loss and loss through interactions. The fragmentation parameters were obtained from 36 interactions, and the S-flux value was obtained from vertical and horizontal zenith angles. The flux of heavy nuclei at the top of the atmosphere was calculated to be 1.7 ± 0.4 from M/H and 1.5 ± 0.2 from $S_0 - M_0$. The data are tabulated. (P.C.H.)

8026 (NP-11232(p.26-37)) RADIO ISOTOPES PRODUCED BY COSMIC RAY BOMBARDMENT OF THE EARTH'S ATMOSPHERE AND THEIR APPLICATION TO

GEOPHYSICAL PROBLEMS. M. G. K. Menon (Tata Inst. of Fundamental Research, Bombay).

Isotopes with half lives of more than one day which are produced by cosmic ray bombardment of the earth's atmosphere are Ar^{39}, Ar^{37}, Cl^{36}, S^{35}, P^{33}, P^{32}, Si^{32}, Al^{26}, Na^{22}, C^{14}, Be^{10}, Be^{7}, and H^{3}. The first nine are produced mainly in the spallation of Ar^{40} nuclei, and the last four result from the spallation of nitrogen and oxygen nuclei. Soon after their formation the isotopes, except for Ar^{37} and Ar^{39}, undergo chemical changes, mainly oxidation. Special attention is given to C^{14}, since it has certain special applications which distinguish it from the others and since it is probably the best illustration of the use of a cosmic ray produced isotope in geophysical domains. Discussion is also given on the detection and concentrations of these isotopes. (P.C.H.)

8027 (NP-11232(p.38-42A)) GAS ČERENKOV COUNTERS FOR PRIMARY COSMIC RAY STUDIES. V. K. Balasubrahmanian and S. K. Roy (Tata Inst. of Fundamental Research, Bombay).

Work carried out on the development of a high pressure gas Cherenkov counter is reported. The difficulties and advantages of using a gas counter are given. The counter was designed as compact as possible. The chamber, 44-cm high and 14-cm in diam, was cylindrical with a spherical top. Light was collected by an inclined concave mirror fitted inside the chamber. Sulfur hexafluoride was used as radiator. The instrument was calibrated at 10 and 3 atm since it is to be employed in assemblies to be flown on plastic balloon flights. The 10 and 3 atm of pressure correspond to α particles and protons in the regions 6 and 16 Bev, respectively. (P.C.H.)

8028 (NP-11232(p.43-8)) A LARGE DETECTOR OF ČERENKOV RADIATION OF SINGLE CHARGED PARTICLE IN AIR. A. Subramanian and S. D. Verma (Tata Inst. of Fundamental Research, Bombay).

A technique for detecting the Cherenkov radiation of single charged particles in air at atmospheric pressure was developed with the object of distinguishing whether a charged particle is a pion or a proton in the energy range at 6 to 40 Bev. The efficiency of association of Cherenkov pulses from the phototube, over an area of 20 × 24 in. and solid angle 0.058 steradian, was observed. The efficiencies obtained were: for mesons (μ) penetrating 10 cm of lead, 18.4 ± 0.63%; for single of 1-Bev electrons, 55 ± 6%. One important observation made was that the mean pulse height in the electron selection triggerings, excluding the cases of no pulses, corresponds to the release of 1.75 ± 0.23 photoelectrons from the cathode of the phototube, which is in agreement within errors with the evaluation of average photoelectron number at extremely relativistic velocities. (P.C.H.)

8029 (NP-11232(p.49-53)) A TOTAL ABSORPTION SPECTROMETER—DESIGN, CALIBRATION AND APPLICATION TO THE STUDY OF HIGH ENERGY COSMIC-RAY PHENOMENA. P. V. Ramana Murty, B. V. Sreekantan, and A. Subramanian (Tata Inst. of Fundamental Research, Bombay).

A spectrometer for energy measurements was constructed of alternate layers of iron and liquid scintillators and based on the principle that if the total ionization loss in the absorber is determined, then the energy of the incident nuclear active particles (n.a.p.) can be determined. The spectrometer is striated into 25 layers and will be calibrated using cosmic ray mesons (μ) penetrating the entire spectrometer. The energy of the nuclear active particles will be known with an accuracy of 30%. In order to avoid space charge effects, signals will be picked up from anodes as well as one of the dynodes of the photomultipliers. To define the solid angle of acceptance for the n.a.p.'s, two sets of crossed neon hodoscopes, each 100 cm long and 1 cm in diameter, were introduced into the spectrometer. Proposed experiments are described. (P.C.H.)

8030 (NP-11232(p.54-56A)) RECORDING AND REPRODUCTION OF COSMIC RAY DATA BY MAGNETIC TAPE. U. D. Desai and G. V. S. S. Raju (Physical Research Lab., Ahmedabad, India).

A 5-track magnetic tape recorder was developed to cater to the following requirements: to furnish hourly and bi-hourly data on solar flares during the normal course of operation; to reproduce data reliably during sudden and abnormal increases of cosmic ray intensity caused by solar flares; and to measure accurately the time of onset of interesting cosmic ray events. One channel is used for timing and the remaining 4 for recording the data. Continuously recorded data can be read by running the tape at a constant speed over the reproducing magnetic tape head. The output pulses from the head are amplified and scaled down by using high gain amplifiers and scalers respectively for reading the data by means of mechanical registers. The device is illustrated. (P.C.H.)

8031 (NP-11232(p.57-60A)) TRANSISTORIZED COSMIC RAY TELESCOPES. U. D. Desai and G. V. S. S. Raju (Physical Research Lab., Ahmedabad, India).

A transistorized unit, which can be operated by battery, was developed for the continuous measurement of cosmic ray intensity. P-N-P alloy junction transistors of type 2N396 were used for pulse shaping and coincidence circuits where high switching action is required. The audio and general switching type transistors are incorporated in the scaling and recording circuits. The principle of the operation is described, and illustrations of the device are given. (P.C.H.)

8032 (NP-11232(p.61-7)) A CRITICAL STUDY OF SOME OF THE I. G. Y. DATA. R. P. Kane (Physical Research Lab., Ahmedabad, India).

A test was made to determine whether stations having approximately similar geographical locations showed similar variations of cosmic ray intensity. When the statistical test was applied to the bi-hourly values of three stations (Leeds, London, and Herstmonceux), it was found that the number of values lying outside the $\pm 2\sigma$ limit was far more than the statistically allowed limit of roughly 1 in 20. This indicated that the nucleonic component intensities recorded at the three places differed from each other by more than 1.5% more often than could be explained on the basis of statistics. Possible reasons for the discrepancies at these three stations and others are discussed. It is concluded that at least some of the I.G.Y. neutron monitor data are not accurate enough to study effects of the order of 1 to 2% or less. (P.C.H.)

8033 (NP-11232(p.69-71)) DEPENDENCE OF DAILY VARIATION ON THE OPENING ANGLE OF THE TELESCOPE. H. Razdan and S. R. Thakore (Physical Research Lab., Ahmedabad, India).

A comparative study of daily variation was made with a narrow angle telescope of opening 5 × 19° and a wide angle telescope of opening 22 × 37°, from 1954 to 1958, during a period from minimum to maximum solar activity. Some interesting changes observed in narrow angle telescopes which were not apparent in a wide angle telescope are discussed. Both narrow-angle and wide-angle telescopes were found to show a shift of yearly mean time of maxima

(ϕ) to later hours from 1954 to 1958, but the change in wide angles was twice that in narrow angles. The dependence of daily variation on north-south opening angles is also discussed. (P.C.H.)

8034 (NP-11232(p.72-80)) COMPARISON OF THE DAILY VARIATION IN EAST AND WEST. U. R. Rao (Physical Research Lab., Ahmedabad, India).

The forms of the daily variation in east and west directions were examined at Ahmedabad by using two sets of telescopes inclined to the zenith at 45°. The data collected during 1957 to 1958 were analyzed after correcting for meteorological factors. It was found that whereas east pointing telescopes show a decisive preference for the diurnal maximum to occur at about noon, west pointing telescopes show a large variability in the occurrence of the diurnal maximum. This indicates that the daily variation is caused, on an average, by an anisotropy situated outside the influence of the geomagnetic field. West pointing telescopes were found to respond to additional low energy particles in the range 22.5 to 10.9 Bev as compared to the east pointing ones, which respond at a lower range. After applying temperature correction, the amplitude of variation in east and west are of the same order. (P.C.H.)

8035 (NP-11232(p.81-91)) WORLD-WIDE CORRELATED CHANGES OF SOLAR DAILY VARIATION AND DAILY MEAN INTENSITY OF COSMIC RAYS. H. S. Ahluwalia (Physical Research Lab., Ahmedabad, India).

Studies were made to determine whether daily variations of the intensity of cosmic rays involve only increases or only decreases or increases as well as decreases. From the analysis of data obtained from various other authors, it was concluded that day to day increases as well as decreases of daily mean intensity do take place on a world-wide basis, and these are correlated with the form of solar daily variation as reflected by the changes in the magnitude of negative bi-hourly deviations centered at appropriate hours. (P.C.H.)

8036 (NP-11232(p.93-5)) TIME VARIATION OF EXTENSIVE AIR SHOWERS OF ENERGY IN 10^{15} EV. B. N. Srivastava and A. N. Suri (D. S. B. Government Coll., Nainital, India).

The results of an experiment performed to study the anisotropy in primary cosmic radiation of 10^{15} ev are given. Data recorded from May to December 1959 were analyzed in solar and sidereal time. From this, it is evident that there are no significant variations in solar time, and the amplitudes of the diurnal and semi-diurnal components are within the statistical errors. The amplitudes and phases were found to vary from month to month, but in the case of semi-diurnal component, the change in phase is less marked. The interesting point in connection with the sidereal daily variation is that the time of occurrence of the maxima coincides with the time at which the milky way is overhead at Naini Tal (lat. 30°N). The rate does not rise sharply at 19 hours sidereal time, but instead shows a broad maxima, spread over six hours from 14 to 20 hours sidereal time. (P.C.H.)

8037 (NP-11232(p.96-100)) DIURNAL VARIATION OF COSMIC RAYS. D. Cattani, M. Galli, C. Maroni, and D. S. R. Murty (Bologna. Universitá. Istituto di Fisica).

For the period December 1957 to June 1958, the amplitude of the mean diurnal variation from peak to peak was about 4.5%. The days in the period were selected according to their magnetic planetary character K_P. The results show that when K_P is high the diurnal oscillation is a little strong, with a maximum that tends to anticipate when K_P increases. On the average during the magnetically disturbed days, the intensity of the cosmic rays tends to diminish, while on less disturbed days, it returns to the normal. A better subdivision of the days with diurnal effect was made on the hypothesis that the diurnal effect depends on the solar activity. It was concluded that the mean intensity tends to diminish strongly only during the maximum fluctuations, while on the remaining days, the intensity increases rapidly. (P.C.H.)

8038 (NP-11232(p.101-7)) COSMIC RAY VARIATIONS AND GEOMAGNETIC ACTIVITY. S. P. Duggal (Physical Research Lab., Ahmedabad, India).

A study was made of the association of C_P (the planetary index of geomagnetic activity) with cosmic ray daily variation in order to further understand the electromagnetic state of interplanetary space. Data obtained from 1955 to 1957 at Trivandrum with vertical meson counter telescopes were analyzed to find an association between cosmic ray daily variation and C_P maxima of four types: Group A—maxima which shows a recurrence on $\pm 27 \pm 1$ days; Group B—maxima which show a recurrence on $+27 \pm 1$ days; Group C—maxima which show a recurrence on -27 ± 1 days; and Group D—no recurrence on either side. The study indicated that on the epoch day the diurnal amplitude is higher in Group B, which represents a fresh type of geomagnetic disturbance. In Group A, a large diurnal amplitude occurs on -1 and -2 days; in Group B it is larger on epoch and $+1$ days; in Group C on $+1$ days; and in Group D on $+2$ days. Thus there is a gradual shift from Group A (recurrent) to Group D (non-recurrent). (P.C.H.)

8039 (NP-11232(p.108-14A)) SOLAR AND TERRESTRIAL RELATIONSHIPS OF INCREASES AND DECREASES OF DAILY MEAN INTENSITY OF COSMIC RAYS WHICH ARE CORRELATED WITH THE MAGNITUDE OF NEGATIVE BIHOURLY DEVIATIONS CENTRED AT 'APPROPRIATE HOURS.' H. S. Ahluwalia (Physical Research Lab., Ahmedabad, India).

Nucleonic component data from Ahmedabad, Kodaikanal, Huancayo, and Makerere obtained during 1958 were used to study the solar and terrestrial relationships of increases and decreases of the daily mean intensity of cosmic rays. From epochs selected on a global basis and under certain criteria, Chree's analysis was performed for the daily mean intensity at Huancayo (I_H), the daily mean intensity at Climax (I_C), planetary index of geomagnetic activity (C_P), and the horizontal component of the earth's field at Kodaikanal (H_K). The results show that day to day increases and decreases are both energy dependent; the larger they are the lower the energy. The increases are associated with low helio latitude formations, and the decreases appear to be associated with an extremely perturbed state of interplanetary space and geomagnetic field. (P.C.H.)

8040 (NP-11232(p.115-21)) SOME COSMIC RAY DECREASES. U. R. Rao (Physical Research Lab., Ahmedabad, India).

Data from some cosmic ray decreases were examined in order to find out if two different types of streams (those probably connected with faculae or with high latitude formations on the sun, and those probably originating in the sun's equatorial region and associated with large spots) cause different types of cosmic ray decreases. The onset time at different places, duration and amplitude of decreases, association of decreases with terrestrial effects, and the changes of primary spectrum were examined. The results show that the storms can be classified into two groups depending on the time interval between the com-

mencement of the fall and the minimum intensity. The properties of both types of storms are summarized. (P.C.H.)

8041 (NP-11232(p.128-35)) SOLAR DAILY VARIATION DURING Sc-TYPE MAGNETIC STORMS AT LOW AND INTERMEDIATE LATITUDES. H. S. Ahluwalia (Physical Research Lab., Ahmedabad, India).

Sc-type magnetic storms which produce a disturbance greater than 25×10^{-4} gauss in the horizontal component of the geomagnetic field were studied. These magnetic storms fall into categories of moderately severe and severe. It was concluded that no simple or unique relation exists between semi-diurnal components of the solar daily variation and Sc-type magnetic storms. The form of solar daily variation undergoes a significant change during the duration of the magnetic storm, in the sense that a subsidiary maximum appears between 4 ± 2 hours (local time) on the day of the onset of the storm which becomes more prominent on the day of the maximum activity of the storm. The subsidiary maximum also seems to be associated with the higher mean energy of the primaries. (P.C.H.)

8042 (NP-11232(p.136-48)) SOURCE AND SPECTRUM OF DAILY VARIATION. U. R. Rao (Physical Research Lab., Ahmedabad, India).

From a list of evidences obtained by different workers for the existence of localized sources causing daily variations and the results of an east-west experiment at Ahmedabad supporting the presence of localized sources of daily variation at certain times, it is concluded that there are at least two sources of daily variation besides the meteorological source—one situated far outside the influence of the geomagnetic field and another situated within the influence of the geomagnetic field. The spectrum of daily variation on days when it is caused by an anisotropy situated far outside the influence of the geomagnetic field is of the form AE^{-1}. The local source of modulation present on high C_p days is believed to be caused by the distortion of the geomagnetic field by tongues of ionized gas emitted from the sun, thus changing the allowed and forbidden zones. (P.C.H.)

8043 (NP-11232(p.150-5)) GEOMAGNETIC EFFECT ON EXTENSIVE AIR SHOWERS. A. Bhaskara Rao and P. S. Gill (Aligarh Muslim Univ., Aligarh, India).

The asymmetry in the rate of showers was measured for three distances, 10, 25, and 40 m, between two counter telescopes. From the results of the experiment, it was concluded that at moderate latitudes and mountain altitudes the geomagnetic field has a significant influence on the distribution of shower particles. The percentage asymmetry between the shower rates from east-west and north-south increases not only with the separation of the telescopes but also with the zenith angle at which the telescopes are inclined. (P.C.H.)

8044 (NP-11232(p.156-9)) A NOTE ON THE THEORY OF GEOMAGNETIC EFFECTS. R. Thunga and T. K. Radha (Madras. Univ.).

Suitable modifications are reduced to that of finding the directions in which particles of given energy coming from infinity can reach any point on the surface of the earth. The curves, $\cos \omega = +1$ and $\cos \omega = -1$, are shown for a given latitude λ, dividing the r-g plane into regions of positive and negative energy, the latter being forbidden. A trajectory of a particle in the meridional plane is characterized by the coordinates r and λ corresponding to a given g and is represented in the r-g plane by a line parallel to the r axis. Geometrical features of the curves which serve to define the Stormer and main cones are also given. The conditions imposed in determining the forbidden directions are that the kinetic energy should be negative, and that the particle be subjected to a negative acceleration. (P.C.H.)

8045 (NP-11232(p.160-4A)) THE EFFECT OF SOLAR RADIO BURSTS ON THE EARTH'S OUTER ATMOSPHERE. K. R. Ramanathan (Physical Research Lab., Ahmedabad, India).

Discussion is given on various works which explain the effects of solar radio bursts on the earth's outer atmosphere. References are made to events following the solar flare of 23.2.56 and 23.3.58, particularly the day-time absorption of cosmic radio noise and the day-time absorption and night-time enhancement of VHF scatter signals in the polar cap which followed these flares and lasted for 4 to 5 days with gradually diminishing intensity; events connected with the solar flare of Sept. 11, 1957 and the associated magnetic storm of Sept. 13; and the different types of solar bursts, particularly the Type IV, which is sometimes associated with Type II bursts. (P.C.H.)

8046 (NP-11232(p.165-71)) EFFECT OF GEOMAGNETIC STORMS ON THE F2 LAYER OF THE IONOSPHERE. K. M. Kotadia (Physical Research Lab., Ahmedabad, India).

The storm-time (Dst) and disturbance-diurnal (SD) variations of the critical frequency of the F2 layer (foF2) and their dependence on the local time of commencement of the magnetic storm are presented. A few individual severe magnetic storms during which large Forbush-type decreases in cosmic rays were observed are discussed in relation to changes in foF2 at a number of stations in low and middle latitudes. The effects observed at Ahmedabad on spread F and cosmic radio noise are also described. (P.C.H.)

8047 (NP-11232(p.172-8)) MAGNETIC STORMS AND COSMIC RADIO NOISE ON 25 Mc/s AT AHMEDABAD. R. C. Bhonsle and K. R. Ramanathan (Physical Research Lab., Ahmedabad, India).

The geomagnetic effects on the ionosphere over Ahmedabad are discussed with the aid of cosmic radio noise data on 25 Mc/s. The method provides a sensitive method of studying the effects of magnetic storms on the F2 layer as a whole, since F2 attenuation depends on the nearness of foF2 to the exploring frequency. The disturbance diurnal variation of the total attenuation of cosmic radio noise shows a dependence on local time. The maximum decrease in total attenuation occurs at about 20 hours local time. An explanation of the observed variation is given in terms of the known variations of foF2 and F-scatter on magnetically disturbed days. After the end of the storm, an over-all increase in attenuation, which lasts for a day, is observed. (P.C.H.)

8048 (NP-11232(p.179-84)) SOLAR ACTIVITY AND MAGNETIC STORMS (REVIEW). P. R. Pisharoty (Colaba Observatory, Bombay).

Solar activity is defined, and the characteristics of SC magnetic storms are given. The effects of solar flares on SC and M-Region storms are also discussed. It is concluded that flares unassociated with radio noise bursts are geomagnetically inactive, and that M-Regions are remnants of centers of magnetic activity. Hydromagnetic theories based on the Chapman-Ferraro Model, which assumes that the initial phase is caused by the neutral but conducting cloud of solar plasma pushing the geomagnetic field inward, are evaluated. (P.C.H.)

8049 (NP-11232(p.185-204)) ELLIOT'S THEORY OF THE TIME VARIATION OF COSMIC RADIATION. P. Morrison (Cornell Univ., Ithaca, N. Y.).

General characteristics of the cosmic ray intensity variation modulation processes are explained in terms of a large scale solar field of predominantly dipole character containing small scale irregularities which act as scattering centers and which is also occasionally very seriously distorted by outward moving solar material. It is concluded that the model appears to be capable of giving a semi-quantitative account of the 11 year variation, the Forbush type decrease, and the solar daily variation. (P.C.H.)

8050 (NP-11232(p.205-8)) PHYSICAL PROCESSES INVOLVED IN TIME VARIATIONS OF COSMIC RAYS. V. Sarabhai (Physical Research Lab., Ahmedabad, India).

The three different types of time variations of cosmic rays are discussed along with three different sources for the variations. Speculation is given on two questions, answers to which would throw some light on the physical processes involved: Does the amplitude of the daily variation or the power of the source of anisotropy decrease or increase with increasing sunspot activity? What can be the origin of a local source of daily variation of non-meteorological origin? It is felt that the latitude belt available in India is advantageous for studying the time variations. (P.C.H.)

8051 (NP-11232(p.209-18)) SOLAR CONTROL OF SOME UNUSUALLY REMARKABLE GEOPHYSICAL EVENTS. S. L. Malurkar (Colaba Observatory, Bombay).

Seven geophysical events, which occurred since January 1942, are listed and discussed. Among the events listed, the surface of the sun (even in latitudinal belts where active regions are found) is not uniform in giving rise to very big events. Only two small longitudinal sectors, in the above latitudinal belt, one near the C.M. and the other near the west limb of the sun, are involved. The major portion of the Sun's surface was practically excluded. Only chromospheric eruptions from active regions of long and more than usually active history gave rise to big cosmic ray bursts in the two restricted areas of the sun. It is concluded from these conditions that the control of events on and near the sun are quite independent of any changes that would be introduced near the earth (geophysical control) or in the space in between the sun and the earth (interplanetary control). (P.C.H.)

8052 (NP-11232(p.219-35)) CHARACTERISTICS OF NUCLEAR INTERACTIONS AT HIGH ENERGIES. D. S. Narayan (Tata Inst. of Fundamental Research, Bombay).

A survey is given of all experimental data and some theoretical deductions based on experimental data which provide information on the characteristics of nucleon-nucleon (N-N) and pion-nucleon (π-N) collisions. The experimental results were obtained from three different fields of investigation, covering different energy ranges. Examples are given that show when one or more parameters characterizing N-N and π-N collisions, which were used in deducing information, must be suitably modified to bring the results from different sources into conformity. The three energy ranges investigated were accelerating machine energies up to 10 Bev, jet-energies from 10^{10} to 10^{14} ev, and extensive air showers from 10^{13} to 10^{18} ev or more. The various characteristics of N-N and π-N collisions that are reviewed are: nature of the secondary particles; multiplicity of secondary particles by various types; energy and angular distribution of secondary particles; and inelasticity. (P.C.H.)

8053 (NP-11232(p.236-42)) τ-MESON DECAY—A REVIEW. A. N. Mitra (Aligarh Muslim Univ., Aligarh, India).

A brief survey is given of the progress made so far in understanding the main features of the problem of τ-decay, as they have emerged from an analysis of the experimental material accumulated over the years. The role of the pion-pion interaction is discussed in relation to this problem. It was concluded from the study that the picture of τ-decay with the pions going out in S states and interacting through the T = 2 state is more consistent with the experimental information than any other hypothesis. (P.C.H.)

8054 (NP-11232(p.243-51)) ON THE MASS DIFFERENCES OF CHARGE MULTIPLETS. V. Devanathan (Madras. Univ.).

Mass differences of $\pi^{\pm}$ and π^0, $K^{\pm}$ and K', protons and neutrons, Σ^- and Σ^+, Σ^+ and Σ^0, and Ξ^- and Ξ^0 are discussed. Self-energy diagrams taken into account are illustrated. From the calculations it was concluded that Ξ^- is heavier than Ξ^+. (P.C.H.)

8055 (NP-11232(p.252-7)) ON THE THRESHOLD EFFECTS IN K^+-n SCATTERING. A. P. Balachandran and N. R. Ranganathan (Madras. Univ.).

A study was made of the behavior of K^+-n direct as well as charge exchange scattering at the threshold of the reaction in which a pion is produced. The phase shifts for K^+-n scattering using only the total cross sections available from the experiments are presented. It is assumed that the spin flip amplitude vanishes. (P.C.H.)

8056 (NP-11232(p.259-65)) EVIDENCE OF AN UNSTABLE PARTICLE OF MASS HIGHER THAN K-MESON AND ITS DECAY MODE. B. Bhowmik and P. C. Mathur (Delhi. Univ.).

Details are given of events which occurred during the course of analysis of decays of K^- mesons in flight. Two events with anomalous Q-values were observed. The mass of the parent molecule in the first event was calculated as $1218 \pm 59\ m_e$, and in the second event as $1251 \pm 87\ m_e$. On the basis of the two observations, the existence of an unstable particle of mass of the order of $1230\ m_e$ is suggested. Reasons are given for ruling out the possibility that the two events could be interactions in flight of a negative K meson. (P.C.H.)

8057 (NP-11232(p.266-82)) WHERE COSMIC RAYS AND HIGH ENERGY PARTICLE ACCELERATORS MEET. Yash Pal (Tata Inst. of Fundamental Research, Bombay).

An evaluation is given of the problem of whether or not it might be possible to build laboratory machines producing energies above 10^{12} ev. A diagram which represents the development of high energy machines with time is given. The rise in energy for the last 30 years is shown to be almost a pure exponential. Information on multi-Bev particle accelerators, such as energy, completion date, focussing type, and cost, is tabulated. (P.C.H.)

8058 (NP-11232(p.283-94)) NUCLEAR INTERACTIONS OF 6 BeV PROTONS. V. Y. Rajopadhye.

By a method of line scan under high magnification, 266 interactions, were picked up. Each interaction was classified according to N_h, the number of heavily ionizing prongs, and n_s, the number of shower tracks. A track having a blob density <1.4 times that of the beam proton track was considered as shower track. The projected and dip angle of each shower track was measured and the space angle (in unprocessed emulsion) was calculated. The median angle of the shower tracks was found to show a variation with N_h. However, there was no evidence to conclude a similar behavior for the median angle of π mesons. The total multiplicity for the small N_h group was found to be 2.04 ± 0.36. The results do not support the tunnel theory. (P.C.H.)

8059 (NP-11232(p.295-301)) DECAY-ASYMMETRY OF COSMIC-RAY MU-MESONS. M. S. Sinha and S. N. Sen Gupta (Bose Research Inst., Calcutta).

An experiment was set up in which 15 cm of lead was placed in between a three-fold coincidence set of G-M counters above a cloud chamber and an anti-coincidence tray of G-M counters just below the cloud chamber. In this system the rate of decay electrons observed was small compared to the rate of stopped muons. So far 881 cases of unambiguous μ-e decay have been obtained in the cloud chamber, 482 of which have been emitted in the upward direction and 399 in the reverse. After a correction was applied to the number of decay electrons coming out of μ mesons which stop in the last (eleventh) plate in the cloud chamber, the anisotropy found was 1.19 ± 0.08, giving a minimum value of 27% for the magnitude of polarization. Other experiments are discussed and the results compared. (P.C.H.)

8060 (NP-11232(p.302-7)) THE SCATTERING OF DECAYING μ-MESONS. S. N. Sen Gupta and M. S. Sinha (Bose Research Inst., Calcutta).

Meson (μ) scattering was studied in the momentum region $40 < p\beta < 170$ Mev/c. The projected scattering angles were measured to an accuracy of 0.2 degree directly on the film with a goniometer eyepiece fitted in a microscope. For each measured projected angle of scattering, the corresponding value of $p\beta$ was determined by estimating the residual range of the particle from the center of the plate in which the scattering was observed up to the point of stopping and decay. From these measurements, a differential distribution of the quantity $p\beta\theta$ was determined. The experimental distribution was then compared with theory. (P.C.H.)

8061 (NP-11232(p.308-15)) THE CHARGED-TO-NEUTRAL RATIO (C/N) OF NUCLEAR ACTIVE PARTICLES. I. L. Chakrabarty (Bose Research Inst., Calcutta).

In order to derive a true estimate of the charged-to-neutral ratio, observed rates were obtained for the detection inefficiency of counter tray T, and possible back projection of ionizing secondary particles from interactions in the producer P, simulating a charged primary. The value of R was found to increase with the increase of energy of the penetrating events. A comparison of the results shows that the ratio R within the energy range 12 to 60 Bev is close to the theoretical value corresponding to $\lambda = 85$ g/cm^2 and $L = 120$ g/cm^2. Since the theoretical value completely ignores the pion contribution, it is emphasized that experimental values obtained should always be slightly higher than the theoretical one. This suggests that the experimental value of R should be compared with the nearest lower theoretical value. This also justifies the estimate of the value of $\lambda = 85$ g/cm^2. (P.C.H.)

8062 (NP-11232(p.321-6)) STRONG INTERACTIONS OF $\bar{K}$ PARTICLES. A. A. Kamal (Osmania Univ., Hyderabad, India).

Experiments were made to determine the charge independence of strange particles. Discussion is given on the reactions $\bar{K} + P \rightarrow \Sigma^- + \pi^-$ and $K^- + n \rightarrow \Lambda^0 + \pi^-$. In order to determine the validity, estimates were made of the branching ratio of π^-/π^+ resulting from various change states in the two reactions. This is given as 1.3. (P.C.H.)

8063 (NP-11232(p.327-36)) INTERACTIONS OF NEGATIVE K-MESONS IN PHOTO-EMULSION. PART I. GENERAL CHARACTERISTICS AND INTERACTION CROSS SECTION. B. Bhowmik, D. P. Goyal, P. C. Jain, and P. C. Mathur (Delhi. Univ.).

The results of experiments carried out in two different emulsion stacks are discussed and tabulated. A total of 353 interactions in flight with visible prongs were observed. An over-all view of the variation of K^- total cross section in emulsion with energy shows that the cross section decreases with increasing energy and attains a constant value of 727 ± 64 mb at high energies. However, the increase at low energies is consistent with the effect of the Coulomb potential. It was concluded that the total average cross section in the energy interval 20 to 180 Mev is 23.58 ± 1.18 cm, and the true total average cross section per nucleus of K^- meson is energy independent. (P.C.H.)

8064 (NP-11232(p.337-45)) INTERACTIONS OF NEGATIVE K-MESONS IN PHOTO-EMULSION. PART II. ANALYSIS OF INTERACTIONS IN FLIGHT. B. Bhowmik, D. P. Goyal, P. C. Jain, and P. C. Mathur (Delhi. Univ.).

Discussion is given on a study of the parameters of the sign fractions π^-/π^+ and Σ^-/Σ^+ and the ratios π/K^- and Σ/K^-. An examination was made of 213 interactions in flight for the presence of a slow electron, blob, and recoil. All the tracks expected to stop inside the stack were followed to their end; on others accurate ionization measurements were made. As a result of the analysis, 48 π mesons and 14 Σ hyperons were obtained. It was concluded that: the sign fractions π^-/π^+ and Σ^-/Σ^+ increase with energy of the interacting K^- meson, thereby indicating an increase in the direct production of Λ^0 and Σ^- hyperons; capture at rest is a surface phenomena, while interaction in flight takes place inside the nuclear volume; and the Σ/K^- ratio is practically constant with energy. (P.C.H.)

8065 (NP-11232(p.346-52)) DECAY MODES AND LIFETIME OF NEGATIVE HEAVY MESONS. B. Bhowmik, P. C. Jain, and P. C. Mathur (Delhi. Univ.).

The relative abundance of K^- decay modes was determined and compared with that of K^+. Forty-four events were obtained in which the primary gave only one flight track, without any visible blob or recoil. All 44 events were taken to be decays in flight. Twenty-two were analyzed for tracks with dip angle $<9°$ and tracks with dip angle $>9°$, but with ionization >1.1 times the minimum. Ionization and scattering measurements were made at several points on the secondary track and a mean value of $p\beta$ was estimated at the decay point. The $K_{\tau 2}^-$ mass was determined as 963.8 ± 7.1 m_e and $K_{\tau 2}^-$ mass as 967.1 ± 9.4 m_e. The mean lifetime is given as $(1.24 \pm 0.19) \times 10^{-8}$ sec. (P.C.H.)

8066 (NP-11232(p.353-9)) IONIZATION MEASUREMENTS IN NUCLEAR EMULSIONS. A. P. Sharma and P. S. Gill (Aligarh Muslim Univ., Aligarh, India).

The relation between probability of development of a grain, π, and the energy loss of the particle, dE/dR, was formulated, and π was determined experimentally for various values of dE/dR by gaplength measurements. Support is given to the theory of recombination. Utilizing the relation between π and dE/dR, if π is measured experimentally, dE/dR can be deduced without calibrating the plate. The scattering-probability method is concluded to be more reliable for finding the mass of a particle, especially for high grain densities. (P.C.H.)

8067 (NP-11232(p.360-6)) MESONIC DECAY OF HYPERNUCLEI PRODUCED BY K^- MESONS AND Σ^- HYPERON. B. Bhowmik (Delhi. Univ.).

The mesonic decay (both neutral and charged) of hyperfragments produced by the capture of K^- mesons and Σ^- hyperons are discussed. Two Ilford emulsion stacks exposed to a magnetically separated K^- beam with a mean momentum of 430 Mev/c were used in the experiment. Nine mesonic decay events were uniquely identified. The details of individual events along with the decay scheme are tabulated, and the short recoil prong was identified from the consideration of momentum balance. The total momentum

due to the proton and pion was computed and the expected range for He^3 and He^4 nuclei for the same given momentum was compared with the observed range of the recoil prong. Event No. 10 was found to be a hyperfragment produced by the capture of a Σ^- hyperon emerging from a K^- star at rest. The length of the hyperfragment was 1.5 μ, and under severe scrutiny was established as being double-centered. The hyperfragment decays mesonically. (P.C.H.)

8068 (NP-11232(p.367-72)) THE INTERACTIONS OF POSITIVE K-MESONS WITH NUCLEI IN PHOTOGRAPHIC EMULSIONS AT ENERGIES IN THE REGION 240 TO 300 MeV. P. K. Aditya, B. M. Anand, I. S. Mittra, K. K. Nagpaul, P. M. Sood, and S. K. Tuli (Punjab Univ., Chandigarh, India).

The characteristics of angular scatterings and elastic and inelastic interactions were studied. Ionization measurements were carried out on both ends of the scatter apex for 40 angular scatterings. Each track was identified to be a K meson. The mean energy of 34 scatters considered to be elastic was calculated as 270 ± 30 Mev. Within experimental errors, the inelastic interacting tracks were also identified as K^+ mesons. The λ inelastic was determined to be 61.5 ± 8.3 cm. (P.C.H.)

8069 (NP-11232(p.373-9)) OBSERVATIONS ON THE DECAY OF K^+-MESONS. P. K. Aditya, J. K. Boeggild, K. H. Hansen, J. E. Hooper, and M. Scharff (Copenhagen. Universitet. Institut for Teoretisk Fysik).

An experiment designed to yield an unbiased range spectrum for the secondary particles emitted in the decay of stopping K^+ mesons is discussed. The number of events and branching ratios for each decay observed are: $K\pi_3$ – 98 events and branching ratio 7.72 ± 0.8%; $K\mu_3$ – 13 events and branching ratio 2.8 ± 0.8%; $K\mu_2$ – 74 events and branching ratio 63 ± 13%; and $K\pi_2$ – 25 events and branching ratio 21 ± 6%. No new or unusual decays were observed. (P.C.H.)

8070 (NP-11232(p.380-5)) LOW ENERGY BREMSSTRAHLUNG AT HIGH ELECTRON ENERGIES. P. K. Aditya (Punjab Univ., Chandigarh, India).

From two stacks of G_5 stripped emulsions exposed in the stratosphere, 17 cascades were selected and grouped into two energy classes: high (325 to 650) and low (40 to 250). From the results of the experiment it is concluded that the decrease of bremsstrahlung cross section for low energy photons is not definitely established up to primary electron energies of 10^{12} ev. This does not prove, however, that the effect does not exist at higher energies. (P.C.H.)

8071 (NP-11232(p.386-91)) AN EXPERIMENT TO STUDY THE CHARACTERISTICS OF HIGH ENERGY NUCLEAR INTERACTIONS USING THE COMBINED TECHNIQUES OF AIR-CERENKOV COUNTER, MULTIPLATE CLOUD CHAMBER AND TOTAL ABSORPTION SPECTROMETER. V. S. Narasimham, Yash Pal, R. Raghavan, P. V. Ramanamurthy, Siddheshwar Lal, B. V. Sreekantan, A. Subramanian, and S. D. Verma (Tata Inst. of Fundamental Research, Bombay).

A multiplate cloud chamber containing a 10-cm carbon block as producer of interactions and six $\frac{1}{4}$-in. brass plates was set up to study high energy nuclear interactions. In addition, two $\frac{1}{2}$-in. lead plates were placed in the bottom of the chamber to absorb the soft cascades, and on top of the cloud chamber an air-Cherenkov was placed. The energy of the particles producing nuclear interactions in the carbon block will be measured by the pulse produced in a total absorption spectrometer and the visible energy in the cloud chamber. The characteristics to be studied are the energy distribution of neutral pions produced in the interactions, angular distribution of the secondaries in the cm system of the colliding particles, order of energy transferred to the target nucleon, and strange particle production rates. (P.C.H.)

8072 (NP-11232(p.392-7)) A CLOUD CHAMBER EXPERIMENT TO STUDY NUCLEAR INTERACTIONS FOR ENERGIES OF THE ORDER OF 50 BeV. Siddheshwar Lal, R. Raghavan, and Yash Pal (Tata Inst. of Fundamental Research, Bombay).

The design, scope, and limitations of the cloud chamber experiment are discussed in the light of experience gained, and an analogue procedure for analysis which can be used to replace laborious calculations is briefly described. Brass plates were originally used in the experiment, but due to the problem of measuring γ energies, it is felt that lead plates would be better. (P.C.H.)

8073 (NP-11232(p.398-407)) SOME CHARACTERISTICS OF ULTRA HIGH ENERGY NUCLEAR INTERACTIONS. P. K. Malhotra and Y. Tsuzuki (Tata Inst. of Fundamental Research, Bombay).

Description is given of five high energy interactions, J2 to J6 Jets with high multiplicity of shower particles, observed in nuclear emulsions. A strip of width 600 μ was scanned (area scanning) all along the jets J3 and J4 under a total magnification of 1500, and 20 secondary interactions giving a value of 39 ± 10 cm were obtained for the interaction mean-free-path of the secondary charged particles. The general characteristics of these interactions and general features of the primary jets are tabulated. (P.C.H.)

8074 (NP-11232(p.408-16)) EXTENSIVE AIR SHOWERS (REVIEW)–1960. B. V. Sreekantan (Tata Inst. of Fundamental Research, Bombay).

Results on extensive air showers reported since 1960 by various groups (MIT, Cornell, Moscow, Tokyo, and Australia) are reported. Discussion is given on number spectrum, anisotropy, the soft component, penetrating component (μ mesons), energy spectrum and absorption mean free path of μ mesons, nuclear active component, and fluctuations. (P.C.H.)

8075 (NP-11232(p.417-22)) NUCLEAR ACTIVE COMPONENT IN EXTENSIVE AIR SHOWERS OF 10^4–10^6 PARTICLES AT SEA LEVEL. PART I. VARIATION WITH SHOWER SIZE. B. K. Chatterjee, G. T. Murthy, S. Naranan, B. V. Sreekantan, and M. V. Srinivasa Rao (Tata Inst. of Fundamental Research, Bombay).

The results of an experiment carried out at Bombay (sea level) on the variation of the number of nuclear interacting particles as a function of shower size are reported. A total of 5000 showers were recorded in three months. The shower size and core position were determined assuming a lateral distribution function for an age parameter, $s = 1.25$. The shower sizes recorded ranged from 10^4 to 2.5×10^6 particles, and the core-distances extended up to 25 m from the center of the array. The lateral distribution of density of the nuclear active particles was calculated for various shower sizes and the results plotted. The results, which extend to smaller shower sized up to 1.6×10^4, show that the slope is 0.45 ± 0.05 up to a shower size of 6.4×10^5 particles and changes to 1.2 for larger sizes. A plot of combined results suggests that a change of slope does occur even at sea level, somewhere around 5 to 8×10^5 particles. (P.C.H.)

8076 (NP-11232(p.423-30)) NUCLEAR ACTIVE COMPONENT IN EXTENSIVE AIR SHOWERS OF 10^4–10^6 PARTICLES AT SEA LEVEL. PART II. FLUCTUATIONS IN THE NUMBER OF NUCLEAR ACTIVE PARTICLES. B. K. Chatterjee, G. T. Murthy, S. Naranan, B. V. Sreekan-

tan, and M. V. Sreenivasa Rao (Tata Inst. of Fundamental Research, Bombay).

Five N-detectors clustered together at the center of the array were used to verify the validity of the assumption that the number of nuclear active particles remain constant in showers of the same electron size. Showers were grouped according to size and distance of core from the center of the N-detectors and the density measured. The results definitely indicate the presence of wide fluctuations. (P.C.H.)

8077 (NP-11232(p.431-5)) T.I.F.R. EXTENSIVE AIR SHOWER EXPERIMENTS AT OOTACAMUND (2.2 kms.). B. K. Chatterjee, G. T. Murthy, S. Naranan, V. S. Narasimhan, P. V. Ramana Murthy, T. N. Ranga Swamy, B. V. Sreekantan, M. V. Sreenivasa Rao, and A. Subrahmanyan (Tata Inst. of Fundamental Research, Bombay).

An experiment which is being set up at Ootacamund with the object of studying various properties of extensive air showers is discussed. The setup is comprised of 16 scintillation counters spread over an area 80 × 80 m. The amplitudes of the pulses from the scintillators enable a fairly accurate determination of the size of the air shower and the position of the core. Showers will be recorded over the range 10^4 to 10^7 particles with the cores striking up to distances of about 100 m from the center of the array. The angle of arrival of air showers will be determined by means of a well shielded μ meson telescope comprised of neon hodoscope tubes. The various phases to be studied are given. (P.C.H.)

8078 (NP-11232(p.436-41)) LATERAL AND ANGULAR SPREAD OF COSMIC RAY SHOWERS. S. C. Ganguly (Calcutta. Univ. Bengal Engineering Coll., Howrah).

The theoretical problem of angular and lateral spread of cosmic ray showers is outlined, and the diffusion equations derived by Landau are given. Explicit solutions up to the first power in K^2 were obtained. (P.C.H.)

8079 (NP-11232(p.442-6)) SOME OBSERVATIONS ON THE PROBABLE CORE OF AN EXTENSIVE AIR SHOWER RECORDED IN AN EMULSION STACK. S. N. Ganguli, N. Kameswara Rao, and M. S. Swami (Tata Inst. of Fundamental Research, Bombay).

A large number of parallel bundles of minimum ionizing tracks (cores) due to high energy γ rays or electrons was observed in a nuclear emulsion stack, and an analysis was made to determine whether the event was a nuclear interaction in the vicinity of the stack or a part of an extensive air shower. An attempt was made to determine whether the shower cores originated from a point in the neighborhood of the stack by the usual convergence method. The total observed energy in the shower was found to be 2.2×10^{14} ev. The density of shower particles showed a sudden drop beyond a centimeter from the shower center and then remained practically constant for several centimeters. The energy flow also showed the same trend as the density distributions and the high energy particles were present near the shower axis only. It was concluded that the most probable interpretation is that it is part of an extensive air shower. (P.C.H.)

8080 (JPRS-11579) TWO ARTICLES ON THE EARTH'S RADIATION BELTS BASED ON DATA FROM THE SECOND SOVIET SPACESHIP. I. OUTER RADIATION BELT OF THE EARTH AT AN ALTITUDE OF 320 KM. S. N. Vernov, I. A. Savenko, P. I. Shavrin, V. E. (Ye.) Nesterov, and N. F. Pisarenko. Translated from Doklady Akad. Nauk S.S.S.R., 140: 787-90(1961). II. THE DETECTION OF THE INNER RADIATION BELT AT AN ALTITUDE OF 320 KM IN THE REGION OF THE SOUTH ATLANTIC MAGNETIC ANOMALY. S. N. Vernov, I. A. Savenko, P. I. Shavrin, and N. F. Pisarenko. Ibid. 1041-4. 16p.

These papers were previously abstracted from the original language and appear in NSA, Vol. 16, Part I abstract no. 3600, and Part II abstract no. 4669.

8081 (JPRS-11686) INVESTIGATION OF EXTENSIVE COSMIC-RAY SHOWERS AT DEPTHS EQUIVALENT TO FORTY METERS OF WATER. Tamas Sandor, Antal Somogyi, and Ferenc Telbisz. Translated from Magyar Fiz. Folyoirat, 9: No. 1, 51-9(1961). 18p.

A 6-fold coincidence-anticoincidence G-M detector circuit is discussed, whose purpose is to detect extensive cosmic showers. The use of this circuit at a depth of 40 m (water equivalent), in conjunction with a second set of detectors at ground level, to determine the μ meson spectrum in extensive showers is described. It is found that the number of μ mesons with energy in excess of E is equal to $E^{-0.33\pm0.07}$. (T.F.H.)

8082 POSSIBLE PATHS FOR RE-ENTRY INTO THE EARTH'S GRAVITATIONAL FIELD AVOIDING THE RADIATION BELTS. W. F. Hilton (Hawker Siddeley Aviation Ltd., London). Astronautica Acta, 7: 325-33(1961). (In English)

Although it is quite possible to traverse the radiation belts sufficiently rapidly to avoid a lethal radiation dose to a human pilot, the vehicle itself will become radioactive, and act as a secondary source, particularly if the vehicle has thick shielding material. Most solar system trajectories will lie close to the plane of the earth's orbit (ecliptic). However, it is suggested that re-entry into the atmosphere should take place in the polar plane, by a very slight inclination of the transfer orbit. This will enable braking ellipses to miss the outer (electron) and the inner (proton) belts altogether, by having successive apogees outside, between, and inside these radiation belts. An alternative solution is to have a single intermediate braking ellipse having apogee between the belts at about 5000 miles altitude (8000 km). Some useful re-entry trajectories are calculated on a digital computer, both for non-lifting ballistic vehicles and for vehicles having a lift/drag ratio of unity. In the latter case the pilot is able to vary his trajectory, and incidentally to raise his perigee height by the application of positive lift followed by a 180° roll and a period of negative lift. (auth)

8083 SOLAR PROTONS AND α PARTICLES FROM THE SEPTEMBER 3, 1960, FLARES. S. Biswas, P. S. Freier, and W. Stein (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 67: 13-24(Jan. 1962).

Solar proton differential energy spectra were measured in emulsions during four flights in the 48-hour interval following the class 3+ solar flare at 0110 UT on September 3, 1960. During these times the spectra were expressed as $dN/dE = \text{const } E^{-\gamma}$ where the constant is a decreasing function of time. The cutoff energy imposed by the earth's magnetic field at Minneapolis, Minnesota, was not sharp even before the sudden commencement of the magnetic storm. During the magnetic storm the cutoff energy is lowered. Solar α particles were observed with an abundance of 3 to 7% of the solar protons of the same rigidity. This abundance ratio was 3% before the magnetic storms and became higher during the storm period. (auth)

8084 TRAPPED PROTON AND COSMIC-RAY ALBEDO NEUTRON FLUXES. Stanley C. Freden and R. Stephen White (Univ. of California, Livermore). J. Geophys. Research, 67: 25-9(Jan. 1962). (UCRL-6603)

A nuclear emulsion stack was flown on an Atlas vehicle

on October 13, 1960. The vehicle went to a maximum altitude of 1185 km. Protons with energies above 17 Mev were measured. The number of protons/(cm^2)(sec)(Mev) between 1000 and 1185 km is 0.6 ± 0.1 of the value obtained on a previous flight of April 7, 1959, between the altitudes of 1000 and 1230 km. The energy distribution is in excellent agreement with that measured on the April 7 flight. The maximum in the energy distribution at 75 Mev observed in July 1959 is no longer visible. At 30 Mev, the energy distribution departs from the theoretical distribution which is calculated using the cosmic-ray albedo neutron decay source and ionization and nuclear collision loss mechanisms. This deviation is probably due to a minimum in the albedo neutron energy distribution caused by a large neutron nonelastic cross section in nitrogen and oxygen at about 20 Mev; the proton energy distribution should rise rapidly below 10 Mev to meet the theoretical curve. The experimental data also fall below the theoretical curve at above 300 Mev. This deviation may be caused by additional loss mechanisms that preferentially affect the high-energy protons, such as the breakdown of the adiabatic condition or the presence of hydromagnetic waves. It may also be due to a trapping probability that decreases with increasing energy or to a neutron energy distribution that drops off more rapidly with energy than the E^{-2} used in the calculation. The albedo neutron energy spectrum is derived assuming it is the only source of the trapped protons and the only loss mechanisms are ionization and nuclear collisions. (auth)

8085 TIME VARIATIONS OF THE ENERGY SPECTRUM OF SOLAR COSMIC RAYS IN RELATION TO THE RADIATION HAZARD IN SPACE. D. K. Bailey (National Bureau of Standards, Boulder, Colo.). J. Geophys. Research, 67: 391-6(Jan. 1962).

Results of a decade of continuous radio observations of polar-cap absorption events are combined with direct determinations of solar cosmic-ray fluxes and energy spectra. From the experimentally determined integral spectra, an idealized evolution of the proton integral energy spectrum during a typical solar cosmic-ray event, isolated in time and producing a large polar-cap absorption event, is developed. It is concluded that previous estimates greatly overestimate the peak radiation hazards. (L.N.N.)

8086 ABSOLUTE ELECTRON INTENSITIES IN THE HEART OF THE EARTH'S OUTER RADIATION ZONE. B. J. O'Brien, J. A. Van Allen, C. D. Laughlin, and L. A. Frank (State Univ. of Iowa, Iowa City). J. Geophys. Research, 67: 397-403(Jan. 1962).

Preliminary data from detectors on Explorer XII are analyzed. The omnidirectional intensity of electrons at >40 kev is typically of the order of 10^8 cm^{-2} sec^{-1}, and at 1.6 to 5 Mev, of 2×10^5 cm^{-2} sec^{-1}. Hence the response of lightly shielded (~1 gm/cm^2) detectors is largely due to direct penetration of primary electrons. (L.N.N.)

8087 BIFURCATION OF THE OUTER VAN ALLEN BELT AND RELATED AURORAL PHENOMENA. Harold L. Stolov (City Coll., New York). J. Geophys. Research, 67: 404-6(Jan. 1962).

It is argued that two separate regions of auroral activity are associated with the outer belt dual structure and that this structure results from neutron beta decay for the inner, and solar injection for the outer branch. (L.N.N.)

8088 LUMINOSITY CURVES OF HIGH AURORAE. Leiv Harang and Anders Omholt (Univ. of Oslo). Geofys. Publikasjoner. Norske Videnkaps-Akad. i Oslo, 22: No. 2, 11p.(1960).

The luminosity variation with height is studied in 23 aurorae with their maximum luminosity at a height between 200 and 400 km. The luminosity curves and absolute intensities of high aurorae are discussed briefly. It is concluded that the primary electrons are dispersed in energies and/or the angles which their paths make with the magnetic field lines and that the number density in the electron bundles causing high rays is of the order 10^2 to 10^4 cm^{-3}. (auth)

8089 PRIMARY COSMIC RADIATION AND EXTENSIVE AIR SHOWERS. B. Peters (Univ. of Copenhagen). Nuovo cimento (10), 22: 800-19(Nov. 19, 1961). (In English)

The hypothesis that separate sources of cosmic particles of widely differing strength predominate in different energy regions is examined. If such separate sources exist and even if they differ in strength by factors as large as 10^2, no significant departure from smoothness in the size-frequency relation of air showers would occur, provided only that all chemical components in the primary radiation have identical spectra when expressed in terms of the magnetic rigidity of the particles or energy per nucleon, and provided further that the chemical composition of the accelerated particle beam does not deviate too radically from its composition at lower energies. While under these conditions, even an infinitely sharp cutoff in rigidity of the particles supplied by the stronger of the contributing sources produces no significant disturbance in the size frequency spectrum of air showers; it produces discontinuities and irregularities in the dependence of other shower parameters on shower size. Each observation seems to support the hypothesis that a rather sharp rigidity cut-off occurs in the source supplying most cosmic particles below this energy. Additional measurable irregularities are predicted. Considerations leading to this hypothesis emphasize the important role which complexity of chemical composition of primary cosmic radiation plays in interpretation of air–shower phenomena. It is suggested that a classification of air showers according to the maximum energy of the nuclear-active particles in the axis may be more relevant to an understanding of underlying nuclear and electromagnetic processes than the total number of shower particles. (L.N.N.)

8090 PRIMARY COSMIC-RAY AND SOLAR PROTONS. Rochus Vogt (Univ. of Chicago). Phys. Rev., 125: 366-77(Jan. 1, 1962).

A study of the low-energy portion of the primary cosmic-ray proton spectrum was made in August and September, 1960. A significant flux of primary protons with energies below 500 Mev, which previously were considered absent, were detected. This result is of importance to astrophysical considerations as it imposes restraints upon possible modulation mechanisms should these particles be of galactic origin. The alternate possibility, namely of solar origin of these particles is also discussed. The observations were made in three high altitude balloon flights at geomagnetic latitudes $\lambda \geq 73°$N. Results show that the low energy proton spectrum observed on quiet days may be represented by $dJ/dE = 2.3 \times 10^4 \times E^{-2}$ protons/m^2 sec-sr-Mev for $78 \leq E \leq 200$ Mev and flattens between 200 and 350 Mev. On september 8, 1960, the observed proton flux between 70 and 350 Mev was several times larger than on quiet days. These protons are believed to have been produced by a class 3 flare on September 3, 1960. Their energy spectrum was measured. (auth)

8091 METHODS FOR DETECTING HIGH ENERGY PHOTONS IN PRIMARY COSMIC RAYS. Takashi Mura-

yama (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 26: 542-53(Oct. 1961). (In English)

Detection of the high energy photons in primary cosmic rays provides useful data for the study of the origin of cosmic rays, because they move in straight lines and bring information on the directions of their sources. Two methods are described to detect such photons through the secondary particles produced by them in air. A part of photons can produce mesons capable of reaching sea level through photonuclear interactions with air nuclei, although the majority are absorbed in the atmosphere by producing electron pairs 10^{10} to 10^{11} ev. These mesons do not suffer considerable scattering from the original direction of photons, and higher intensities of mesons in a small solid angle containing the direction of the source can be detected in comparison with the average intensity. The lower limit of the photon flux detectable by this method is about 4.10^{-6} cm^{-2} sec^{-1} for photons of 200 Bev. For photons near 10^{12} ev, it is possible to detect cascade showers initiated when observations are made at mountain altitude. Discussions are given on the detection efficiency of these showers by the special arrangement of shower detectors. The minimum detectable flux of photons of 10^{12} ev by this arrangement is about 2.10^{-7} cm^{-2} sec^{-1}. (auth)

Criticality Studies

8092 (DP-311) RADIATION BURSTS IN U^{235} SOLUTIONS. Hugh K. Clark (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1958. Contract AT(07-2)-1. 22p.

Calculations were made of the magnitude of the radiation bursts that can occur in a mixer-settler and in a large tank containing U^{235} solution if the concentration gets out of control. Various rates of increase in concentration were studied and various restraints were imposed on the expansion of the systems. The neutron kinetics equations, with five groups of delayed neutrons, and the equations relating the neutron flux to the pressure and volume of the gas formed by fission fragments were combined into a single first-order nonlinear differential matrix equation which was solved numerically on the IBM 650. In a mixer-settler containing 9.7 kg of U^{235} the magnitude of the burst was calculated to be about 10^{17} fissions, both for low rates of increase in reactivity ($\leq 0.01\%$ per sec) regardless of the confinement, and for an unconfined system regardless of the rate of increase in reactivity. In a tank containing 88.9 kg of U^{235} successive bursts of about 10^{19} fissions were calculated to occur about 0.5 second apart when the rate of increase in reactivity was about 0.1% per second. (auth)

8093 (DP-644) NUCLEAR PARAMETERS OF MASSIVE URANIUM RODS IN D_2O. Frank E. Kinard (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Nov. 1961. Contract AT(07-2)-1. 42p.

Measurements were made of the nuclear parameters of heavy-water-moderated lattices of uranium metal rods, 3 inches in diameter and enriched to 3.0 wt % U^{235}, at a triangular lattice pitch of 18 inches. The value of k_∞, obtained from the four-factor formula with experimental values of f, η, ϵ, and p, agreed to within 0.6% with the value obtained from the two-group diffusion kernel together with experimental values of L^2 and B_m^2. The value of k_∞ obtained from the four-factor formula using experimental values of the parameters agreed within 0.5% with that obtained by inserting calculated values, but the measured and calculated values of the individual parameters differed by as much as 3%. (auth)

8094 (HW-50257) EXPONENTIAL MEASUREMENTS WITH ENRICHED URANIUM IN GRAPHITE LATTICES. E. D. Clayton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 17, 1957. Contract W-31-109-Eng-52. 41p.

A series of buckling measurements was undertaken in wet and dry graphite lattices at spacings of $4^3/_{16}$ to $10^3/_8$ in. for U^{235}–aluminum fuel elements for U^{235} compositions of 38.33 and 16.45 g by means of critical size from multiplication measurements, exponential methods, and quasi-exponential methods. Wet lattice bucklings, at small spacings, are considerably higher than the dry lattice bucklings, because of the smaller age in the lattices which overcompensate for the increased thermal leakage and decreased k_∞. The extrapolation length and the graphite reflector savings for a rectangular prism of 4×4 ft cross sectional dimensions were determined for the lattices measured. (B.O.G.)

Elementary Particles and Radiations

Refer also to abstracts 8052, 8053, 8054, 8055, 8056, 8058, 8062, 8063, 8064, 8065, 8067, and 8069

8095 (IFA-EM-45) ASYMMETRIC MESON EMISSION IN 23.5 GeV PROTON INTERACTIONS. E. M. Friedlaender and M. Spirchez (Academia R. P. R. Institutl de Fizica Atomica, Bucharest). 1961. 8p.

A study is made of 116 meson showers (multiplicity ≥ 3) produced by the collision of 23.5-Bev protons on light emulsion nuclei. It is found that asymmetric showers, peaked either forward or backward, constitute between $^1/_3$ and $^1/_2$ of the total number of observed showers. The experimental results are shown to be compatible with a one-pion-exchange model for the interaction. (T.F.H.)

8096 (JINR-D-774) ON PHENOMENOLOGICAL ACCOUNT OF PION-PION INTERACTION. L. D. Solov'ev (Solovyov) and Jung-mo Chen (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 22p.

By assuming the existence of the resonances in the two-pion p-state of the isotopic spin 1 and in the three-pion p-state of the isotopic spin 0, the relations between different processes at low energy are established. Nucleon form-factors, elastic pion-nucleon scattering, pion-pion s-wave scattering, pion form-factors, and photoproduction, as well as inelastic pion-nucleon scattering, are considered. (auth)

8097 (JINR-P-797) UPRUGOE RASSEYANIE PROTONA NA PROTONE PRI ENERGII 2.8 BEV. (Elastic Scattering of Protons on Protons at 2.8 Bev). S. A. Azimov, Ying-seb To, L. F. Kirillova, E. M. Khabibullina, E. N. Tsyganov, M. G. Shafranova, B. A. Shakhabazyan, and A. A. Yuldashev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 11p.

The elastic proton-proton scattering was investigated at 2,8 Bev using the emulsion method. There were found 492 events of elastic scattering. The differential cross section for elastic proton-proton scattering was obtained in the angle interval 2.5 to 20.5° in the center-of-mass system. The experimental data are not in agreement with the assumption about the smallness of the spin interaction and the real part of the phase shifts. The root-mean-square radius of the proton-proton interaction is found to be (1.06 ± 0.10) f. (auth)

8098 (JINR-P-809) O REAKTSII $\pi^- + p \rightarrow \Lambda^0 + K^0$. (The $\pi^- + p \rightarrow \Lambda^0 + K^0$ Reaction). Yu. Vol'f (J. Wolf) and G. Domokosh (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 8p.

The differential cross section of the reaction $\pi^- + p \rightarrow \Lambda^0 + K^0$ is calculated with one K′ particle in the intermediate state. Radiation corrections to the propagator and vertices are taken into account. The results make it probable that K′ has spin one. (auth)

8099 (NEVIS-97) THE PARITY OF THE NEUTRAL PION AND THE DECAY $\pi^0 \rightarrow 2e^+ + 2e^-$. N. P. Samios, R. Plano, A. Prodell, M. Schwartz, and J. Steinberger (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.). Jan. 1962. Contracts Nonr-266(72) and AT(30-1)-1932. 25p.

Two hundred and six electronic decays of the π^0, $\pi^0 \rightarrow e^+ + e^- + e^+ + e^-$, were observed in a hydrogen bubble chamber. The decay distributions of the electron pairs and the total rate for this process are shown to be in good agreement with theory. An examination of correlations of the e^+e^- pair decay planes on the basis of electrodynamic predictions is in agreement with the hypothesis that the π^0 is pseudoscalar, but disagrees for scalar pions by 3.6 standard deviations. (auth)

8100 (NYO-9282) THE LEPTON DECAY MODES OF HYPERONS. David R. Harrington (Carnegie Inst. of Tech., Pittsburgh). Apr. 1961. Contract AT(30-1)-882. 79p.

Dispersion relations are formulated for the $Y \rightarrow N + l + \nu$ form factors, taking into account an anomalous threshold just below the normal threshold. These relations are used to estimate the one- and two-meson contributions to the $\Lambda \rightarrow \rho + l + \nu$ form factors. The results indicate that the decays are dominated by V and A subtraction constants, somewhat reduced from the "universal" value, although there may be a noticeable correction to $\Lambda \rightarrow \rho + \mu + \nu$ due to an "induced scalar" term. The corresponding contributions to the decay amplitudes for $Y \rightarrow N + \pi$ are estimated. These contributions may be as large as one third of the experimental amplitude. (auth)

8101 (NYO-9283) INTERACTIONS OF 141 MEV NEGATIVE PIONS WITH DEUTERIUM. Edward G. Pewitt (Carnegie Inst. of Tech., Pittsburgh). May 1961. Contract AT(30-1)-882. 108p.

The interactions of 141-Mev π^- mesons with deuterium were studied using a bubble chamber. The elastic differential cross section was measured at $\Theta_\pi^{Lab} = 30$ to 180° by examining the angular correlation, range of positive recoil, and coplanarity of those scatterings which resulted in two outgoing charged particles. The accuracy of the measurements in the backward hemisphere was of the order of 10 to 15 per cent. This elastic differential cross section was compared to the results of impulse approximation calculations and found to disagree for backward scattering. The differential cross section for the sum of elastic plus inelastic scattering ($\pi^- + d \rightarrow \pi^- + d$ or $\pi^- + d \rightarrow \pi^- + p + n$) was measured at $\Theta_\pi^{Lab} = 10$ to 180°. The cross section for elastic plus inelastic scattering was determined to be 137 ± 7 mb. The cross section for the three reactions giving neutral products ($\pi^- + d \rightarrow 2n, 2n + \pi^0$, and $2n + \gamma$) was found to be 34.4 ± 2.6 mb. This gave a $\pi^- + d$ total cross section of 171 ± 7 mb. The results are compared with impulse approximation calculations. (auth)

8102 (NYO-9758) CALCULATION OF EXACT EIGENFUNCTIONS OF SPIN AND ANGULAR MOMENTUM USING THE PROJECTION OPERATOR METHOD. Aubey Rotenberg (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). Aug. 15, 1961. Contract [AT(30-1)-1480]. 25p.

The projection operator technique is used to generate electronic wave functions which are eigenfunctions of both spin and orbital angular momentum. All the functions which arise in the L-S coupling of any allowed system of electrons in a single s, p, d, or f shell are computed as well as some functions for a few electrons in the g-shell. In addition, functions arising in the coupling of electrons in different shells are obtained, and these eigenfunctions are of particular interest in configuration interaction studies of atomic structure. A few representative eigenfunctions are listed. (auth)

8103 (TID-14475) THE SCATTERING OF NEUTRONS BY α-PARTICLES. S. M. Austin, H. H. Barschall, and R. E. Shamu (Wisconsin. Univ., Madison). [1961]. Contract [AT(11-1)-Gen-7]. 39p.

Angular distributions of neutrons scattered by α-particles were measured at neutron energies between 2 and 23 Mev by observing recoiling α-particles in a high-pressure gas scintillator. At the highest bombarding energy, the disintegration of α-particles by neutrons was also observed. Total cross sections of helium were measured at four neutron energies between 7 and 12 Mev in a simple transmission experiment. The total cross sections agree with values calculated from the analysis of p-α scattering by Dodder and Gammel. The angular distributions agree with these calculations quite well up to a neutron energy of 15 Mev, but not as well at higher energies. At the higher energies, the disagreement is even greater with calculations based on an analysis of p-α scattering by Gammel and Thaler. (auth)

8104 (UCRL-6320) PRECISION MEASUREMENT OF THE NEUTRON-PROTON COHERENT SCATTERING AMPLITUDE. W. C. Dickinson, L. Passell, W. Bartolini, and O. Halpern (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 11, 1961. Contract W-7405-eng-48. 63p.

Four independent measurements were made of the ratio, $a_C/|a_H|$, of the carbon to the hydrogen coherent scattering amplitudes, using liquid hydrocarbon mirrors with various ratios of hydrogen to carbon atoms. In two of these measurements the reflected neutron intensity from different liquids was compared for a fixed angle of reflection. In the other two measurements the angles were determined for which the same reflected intensity was obtained. The most accurate value for the ratio of the nuclear amplitudes (correcting for neutron-electron scattering) obtained from one of the constant-intensity measurements, was $a_C/|a_H|$ (nuclear) = 1.775 ± 0.004. Combining this value with the presently accepted value of the carbon scattering amplitude, $a_C = (6.64 \pm 0.02) \times 10^{-13}$ cm, the best value for the proton scattering amplitude was found to be $a_H = (-3.74 \pm 0.02) \times 10^{-13}$ cm. (auth)

8105 (FTD-TT-61-183) THE APPLICATION OF THE EXPANSION METHOD TO THE ELASTIC SCATTERING OF SLOW ELECTRONS BY HEAVY ATOMS. V. D. Kamenetskii (Kamenetskiy) and B. M. Yavorskii (Yavorskiy). Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 5, 26-34(1960). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 13597.

8106 MANY-BODY PROPAGATORS OF A SELF-COUPLED SPINOR FIELD IN EDWARDS–LIEB'S APPROXIMATION. G. Pócsik (Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung., 13: 255-64(1961). (In English)

The continuous integral representation of the complete, many-body propagators of a self-coupled spinor field is deduced and investigated. The continuous integrals are calculated by means of the Edwards-Lieb non-perturbative approximation method. In the first approximation, the physical one-body propagator agrees with the propagator of a free, dressed particle and the physical two-body propagator corresponds to the one obtained in the "closed-loop chain" approximation of A. A. Abrikosov et al. (Phys. Rev. 111, 321(1961)). (auth)

8107 ON THE K-MESONIC INTERACTION OF MUONS. P. Vértes (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung., 13: 341-3(1961). (In English)

The problem of the muon mass in the field-theoretical interpretation of the origin of mass of elementary particles is considered in terms of the nucleon-kaon interaction. G. Gyorgyi's formula is used (Nucl. Phys. 10, 197(1957)). The interaction is not renormalizable, but the cutoff formula may be calculated from the correction of the muon's self mass. Taking into consideration the electromagnetic interaction, the anomalous magnetic moment of the kaon self mass is calculated. (L.N.N.)

8108 STATISTICAL METHODS IN HIGH-ENERGY PHYSICS. Martin Kretzschmar (Univ. of California, Berkeley). Ann. Rev. Nuclear Sci., 11: 1-40(1961). (UCRL-9621).

The Fermi model for multiple pion production is considered. Final-state interactions are discussed and consideration is given to phase-space integral calculation, thermodynamic approximation, and isotopic spin conservation. Charge states are analyzed. Applications of the statistical methods to meson production in nucleon-antinucleon annihilation, pion-nucleon interactions, and nucleon-nucleon interactions at below 30 Bev and at cosmic-ray energies are discussed. (L.N.N.)

8109 APPLICATION OF THE METHOD OF MAXIMUM LIKELIHOOD TO THE ESTIMATION OF THE MAGNETIC CURVATURE OF CHARGED PARTICLE TRAJECTORIES IN BUBBLE CHAMBERS. Marcel Huybrechts (Institut Interuniversitaire des Sciences Nucléaires, Brussels). Bull. classe sci., Acad. roy. Belg., (5) 47: 739-49(1961). (In French)

The method of maximum likelihood is applied to the estimation of the magnetic curvature of charged particle trajectories in bubble chambers, using measurements made on points approximately equidistant from the projection of the tracks on a plane perpendicular to the magnetic field. (tr-auth)

8110 THE GRAVITATIONAL EFFECT OF SPIN ON THE PARTICLE WITH ZERO SPIN. Olivier Costa de Beuregard. Compt. rend., 253: 1761-3(Oct. 23, 1961). (In French)

In order to support his version of the hypothesis of the gravitational effect of spin, the author generalizes the wave equation of a particle with spin in a gravitational potential at the linear approximation to the asymmetric case. It is shown that the kinetic or self pulse-energy varies according to the law of the combined Coriolis and ordinary inertial effect, which is the formula given previously (Compt. rend. 250, 984(1960)) for the gravitational effect of spin. (J.S.R.)

8111 THE QUANTUM THEORY OF UNSTABLE ELEMENTARY PARTICLES. L. A. Khalfin (Steklov Mathematics Inst., Leningrad Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 599-602 (Nov. 21, 1961). (In Russian)

Ordinary unstable elementary particles which decay by weak interaction with a lifetime of 10^{-8} to 10^{-10} sec are described by the following dispersion distribution: $\Delta(E) = C/[(E-E_0)^2 + \Gamma^2]$, where C is a normalizing constant, $\Delta(E)$ is the density of energy distribution (or mass distribution), E_0 is the "mass" of the unstable particle and Γ is related to the manner of decay. The term Γ/E_0 is $\sim 10^{-15}$ for ordinary unstable particles. The "arrangement" function $\phi(E)$ characterizes the fine details of the unstable state, but E_0 and Γ depend only slightly on the details of this model. However, in principle the "arrangement" function can be determined with greater accuracy by studying the mode of decay. Recently, the existence of very shortlived particles has been proven for which $\Gamma/E_0 \sim 10^{-1}$. It is shown mathematically that the terminal parameters E_0 and Γ describing an ordinary unstable particle are uniquely determined from a given mode of decay. Hence, a careful experimental study of the shape of a resonance for particles where $\Gamma/E_0 \sim 10^{-1}$ can give information on the distribution of mass of an unstable particle. (TTT)

8112 PARTICLE MOTION IN THE EQUATORIAL PLANE OF A DIPOLE MAGNETIC FIELD. E. H. Averett (Harvard Univ., Cambridge, Mass.). J. Geophys. Research, 67: 53-8(Jan. 1962).

An exact relation is derived describing bound-particle orbits in the equatorial plane of a dipole magnetic field. An exact expression is then obtained for the average angular velocity of the particle about the dipole axis. The corresponding drift velocity is compared with the usual first-order expression based on a constant local field gradient. It is shown that the first-order expression for the drift velocity can be considerably in error when the particle loops are not small compared with the mean distance from the dipole axis. (auth)

8113 SCATTERING OF POLARIZED PROTONS BY A TARGET OF POLARIZED PROTONS. J. Raynal (Centre d'Études Nucléaires, Saclay, France). Nuclear Phys., 28: 220-43(1961). (In French)

Proton-proton scattering, in the helicity formalism, is studied for a polarized target and a polarized incident beam. Exact expressions are given as well as their approximations when only S, P, and D waves are considered for the four sets of phase-shifts fitting the cross section in range 10 to 40 Mev. The polarization is found to be a higher order effect than the correlation coefficients, and it is shown that the four sets of solutions give only two different angular distributions of the spin correlation coefficient. (auth)

8114 DISPERSION RELATIONS, 'CAUSAL' INEQUALITIES AND THE COMPLETENESS OF THE SET OF EIGENSTATES IN NON-RELATIVISTIC POTENTIAL SCATTERING. I. Saavedra (Imperial Coll. of Science and Tech., London). Nuclear Phys., 29: 137-52(1962). (In English)

The connection between the causality condition (N. G. Van Kampen, Phys. Rev. 91, 1267(1953)) and the dispersion relations satisfied by the scattering matrix in the non-relativistic problem is considered, and it is shown that in a certain limit, attained by explicitly abandoning the mathematical framework of quantum mechanics, the requirement of causality reduces to a restriction on the system which is in general not sufficient to guarantee the dispersion relations, namely, the Wigner 'causal' inequality for a given partial wave. It is then shown that when the problem is reconsidered, under the general assumption that the wave functions describing the system form a complete set of states, not only the dispersion relations, but also Van Kampen's causality condition and

Wigner's inequalities can be rigorously derived from it. (auth)

8115 SOURCES OF POLARIZED PROTONS AND DEUTERONS. R. Beurtey, A. Papineau, and J. Thirion (Centre d'Etudes Nucleaires, Saclay, France). Nuovo cimento (10), 19: Suppl. No. 2, 207-20(1961). (CEA-1802). (In French)

A review is given of the different methods used to produce beams of polarized protons. The construction of a polarized proton source based on the adiabatic passage principle of F. Bloch, as proposed by A. Abragam and J. M. Winter, is described. Experiments made on the described equipment indicate that the polarization of the protons in the neutral beam is nearly 100%. The results also show that the deuterons are partially polarized. (N.W.R.)

8116 CONFORMAL INVARIANCE OF MASSLESS DIRAC-LIKE WAVE EQUATIONS. J. S. Lomont (Polytechnic Inst., Brooklyn). Nuovo cimento (10), 22: 673-9 (Nov. 16, 1961). (In English)

It is shown that all Dirac-like wave equations with positive integral or half-integral spin, zero rest mass, and no interaction are conformally invariant. The transformation of Ψ under the conformal group, and the associated conservation laws are given. (auth)

8117 ON THE ANALYTICITY OF PARTIAL WAVE AMPLITUDES FOR UNSTABLE PARTICLES IN PERTURBATION THEORY. A. W. Hendry (Glasgow Univ.). Nuovo cimento (10), 22: 680-8(Nov. 16, 1961). (In English)

Two-particle scattering processes with one outgoing particle unstable are investigated. The singularities of the physical scattering amplitude and the corresponding partial wave amplitudes are obtained. (auth)

8118 THE DETERMINATION OF THE SCATTERING POTENTIAL FROM THE SPECTRAL MEASURE FUNCTION. V. THE GELFAND-LEVITAN EQUATION FOR THE THREE-DIMENSIONAL SCATTERING PROBLEM. I. Kay (New York Univ., New York) and H. E. Moses. Nuovo cimento (10), 22: 689-705(Nov. 16, 1961). (In English)

A Gelfand-Levitan equation is introduced that enables calculation of scattering potentials from part of the scattering amplitude in the three-dimensional scattering problem. The Gelfand-Levitan equation is a generalization of the one-dimensional Gelfand-Levitan equation. The part of the scattering amplitude required is an analogue of the reflection coefficient in one dimension. The potential obtained is more general than that usually assumed in the three-dimensional scattering problem; it is diagonal in the radius variable but is a real integral operator in terms of the angular variables. The purely local potential (i.e. the potential diagonal in radial and angular variables) appears as a special case. It is assumed that the perturbed Hamiltonian has a purely continuous spectrum coinciding with that of the unperturbed Hamiltonian. (L.N.N.)

8119 GENERAL THEORY OF ČERENKOV RADIATION. G. Zin (Università, Turin). Nuovo cimento (10), 22: 706-78(Nov. 16, 1961). (In Italian)

Cherenkov radiation emitted by a charge in random motion is considered. Viewpoints corresponding to the Lagrangian and Eulerian of fluid dynamics are introduced. A theorem furnishing Fourier time transforms of potentials and fields generated by a moving elementary charge is obtained. Antitransforms are derived, and applications of the method used are presented. (L.N.N.)

8120 THE SCATTERING OF POSITIVE 120 Mev PIONS ON PROTONS. A. Loria (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua), P. Mittner, R. Santangelo, et al. Nuovo cimento (10), 22: 820-43 (Nov. 16, 1961). (In English)

An investigation of the elastic scattering of 120-Mev π^+ by protons is described. The experiment was performed by exposing a liquid propane chamber to the CERN 600-Mev synchrotron. The results refer to 5405 selected events in which the contamination from scattering on carbon nuclei is shown to be negligible. The values obtained for the phase-shifts are: $\alpha_{31} = -2.60° \pm 0.69°$, $\alpha_3 = -11.05° \pm 1.32°$, $\alpha_{33} = 31.67° \pm 1.01°$. The value of α_3 differs significantly from that expected if the linear dependence of α_3 on the momentum, which was proposed, is assumed. The result is discussed in connection with theoretical developments. (auth)

8121 REMARKS ON COMPLEX SINGULARITIES OF THE VERTEX FUNCTION AND NAKANISHI'S CONJECTURE. S. Dembinski (Univ. of Wrocław, Poland). Nuovo cimento (10), 22: 844-6(Nov. 16, 1961). (In English)

Possibilities of double dispersion representation for matrix elements are discussed. Conditions sufficient for invalidity of the representation are presented. These conditions include the case in which the region where the function is real is bounded by some piece of the Landau curve and and the case in which this region is bounded with only one variable singularity and a hypersurface entirely attached to parts of the Landau curve from the region of virtual singularities where cuts overlap. (L.N.N.)

8122 TWO MODES OF MEASURING SPURIOUS SCATTERING IN NUCLEAR EMULSIONS. E. Dahl-Jensen (Inst. for Theoretical Physics, Copenhagen), M. Gailloud, W. O. Lock, and G. Vanderhaeghe. Nuovo cimento (10), 22: 850-2(Nov. 16, 1961). (In English)

Two methods for measuring spurious scattering in nuclear emulsions are given. One pertains to the case in which scattering measurements are performed on isolated tracks of known energy in an emulsion; the other, to relative measurements on pairs of tracks close together, in the case of high flux density of incident beam particles. Recommendations on actual measurements and on the scattering constant are presented. (L.N.N.)

8123 ON THE BEHAVIOUR OF THE MULTIPLE SCATTERING CONSTANT, K, FOR NUCLEAR EMULSIONS, AT LARGE CELL SIZES. A. Hossian, M. F. Votruba, A. Wataghin, and D. Evans (CERN, Geneva). Nuovo cimento (10), 22: 861-3(Nov. 16, 1961). (In English)

Previous results from multiple scattering measurements of high-energy particle tracks in nuclear emulsions indicate a possible discrepancy between theoretically expected values of the mean scattering angle and that found experimentally at cell sizes greater than 1 cm. Further evidence is presented; tracks produced by 16.2-Bev/c π^- and 8.2-Bev/c μ^- are analyzed. The value of the scattering constant needed to fit the data for cell sizes greater than 1 cm is calculated. The unimportance of the nuclear-force contribution and an extended charge for the nucleus are suggested. (L.N.N.)

8124 V − A OR V + A INTERACTION IN μ-MESON CAPTURE? R. Silbar and H. Ueberall (Univ. of Michigan, Ann Arbor). Nuovo cimento (10), 22: 864-6(Nov. 16, 1961). (In English)

The extent to which the μ capture interaction is determined by present evidence is investigated, and a negative relative sign of vector and axial vector coupling is established. The analysis is based on the effective μ capture interaction (A. Fujii and H. Primakoff, Nuovo Cimento 12, 327(1959); H. Primakoff, Rev. Mod. Phys. 31, 802(1951))

and considers capture rates, neutron asymmetries, and the hyperfine effect. (L.N.N.)

8125 INTEGRAL EQUATIONS FOR THE PROCESS $3\pi \rightarrow 3\pi$. P. Carruthers (Cornell Univ., Ithaca, N. Y.). Nuovo cimento (10), 22: 867-9(Nov. 16, 1961). (In English)

The asymmetry of the isospin-zero 3-pion wave function under interchange of any pair permits each pion to interact with others through the strong p-wave, isospin-1, π-π force. A model in which the pions interact two at a time in the p-wave, isospin-1 (resonant) state is considered. It is shown that all graphs of this type are summed by a simple integral equation for the scattering amplitude $3\pi \rightarrow 3\pi$. (L.N.N.)

8126 THREE-PION FORM FACTOR FROM ELECTRON-POSITRON EXPERIMENTS. G. Da Prato and G. Putzolu (C.N.E.N., Frascati, Italy). Nuovo cimento (10), 22: 870-1(Nov. 16, 1961). (In English)

The reaction $e^+ + e^- \rightarrow \pi^+ + \pi^- + \pi^0$ was analyzed experimentally, following preliminary calculations based on previous work (N. Cabibbo and R. Gatto, Phys. Rev. Letters 4, 313(1960)). A 3π resonance peak was found at E = 525 Mev. (L.N.N.)

8127 POSSIBLE INTERPRETATION OF THE 1815 Mev $\bar{K}$p RESONANCE AS A $\bar{K}^*$N BOUND STATE. W. Królikowski (Univ. of Washington, Seattle). Nuovo cimento (10), 22: 872-4(Nov. 16, 1961). (In English)

It is noted that the sum of the masses of the nucleon (M_N = 939 Mev) and the $\bar{K}^*$ meson ($M_{\bar{K}^*}$ = 885 Mev) is 1824 Mev. Thus the 1815-Mev $\bar{K}$-N resonance is interpreted as a $\bar{K}^*$-N bound state with isospin T = 0 and binding energy about 9 Mev. It is suggested that this bound state cannot be explained by a globally symmetric mechanism and is an S state. (L.N.N.)

8128 SOME REMARKS ON THE WICK PRODUCT OF INTERACTING FIELDS. A. Campolattaro and M. Marinaro (Università, Naples and Istituto Nazionale di Fisica Nucleare, Naples). Nuovo cimento (10), 22: 879-83(Nov. 16, 1961). (In English)

Effects of changing the definition of the Wick product (G. C. Wick, Phys. Rev. 80, 268(1950)) or omitting its use are discussed. It is shown that if all calculations involving formally divergent integrals satisfy specific consistency requirements, the difference is manifested merely as a phase factor. With different physical requirements, these conclusions also hold for many-body problems. (L.N.N.)

8129 LOW-ENERGY CONTINUOUS X-RAY SPECTRUM IN THE 80 A TO 180 A REGION. T. J. Peterson, Jr. and D. H. Tomboulian (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 125: 235-41(Jan. 1, 1962).

The relative intensity measurements of the soft x-ray continuous radiation from Mg, Al, Mn, Cu, Ge, and Ag targets bombarded by low-energy electrons are discussed. The investigations lie in the region from 80 to 180 A. Photometric measurements were carried out using a previously calibrated grazing incidence spectrograph. In all cases the target layers were prepared by deposition in high vacuum. Accelerating potentials ranged from 600 to 3000 v. Attempts were made to investigate the dependence of the intensity on the takeoff angle. Factors which might modify the source distribution are considered. For incident electrons in the above-mentioned range, the observed intensity at a wavelength λ can be represented by a functional form such as $1/\lambda^{\alpha}$, where the parameter α is found to be in the range from 1.8 to 2.7. This parameter is related to the accelerating potential, the atomic number, and ν/ν_0, where ν is the radiated frequency and ν_0 is the high-frequency limit. In the cases of Mg and Mn where the incident electron energies were of the order of 600 ev, comparison reveals that the observations are in agreement with numerical presentations of the Sommerfeld thin-target theory which assumes one radiating interaction between the incident electron and a single layer of target atoms. (auth)

8130 SCATTERING OF NEUTRONS BY ALPHA PARTICLES. F. Demanins (Università Trieste, Italy), G. Pisent, G. Poiani, and C. Villi. Phys. Rev., 125: 318-20 (Jan. 1, 1962).

A precision n-α scattering experiment was carried out at 2 to 3 Mev. The angular distribution of neutrons elastically scattered by alpha particles was measured at angles smaller than those considered in similar experiments. Phase-shift analysis of the data was conducted. No D waves are detectable. The phase shifts for the interaction in the L = 0 and L = 1, J = $^3/_2$ state agree very well with the values quoted in the literature. The phase shift arising from the interaction in the L = 1, J = $^1/_2$ state turns out to be much smaller than expected; it was found $\delta^1_{1/2} = 4°$ at 2.37 Mev and $\delta^1_{1/2} = 8°$ at 2.87 Mev, instead of ~20° in this energy interval. Such an experimental result should be carefully considered in theoretical investigations concerning the spin-orbit potential, and in experimental researches using helium as a polarization analyzer. (auth)

8131 PHOTOPRODUCTION OF POSITIVE PIONS FROM HYDROGEN NEAR THRESHOLD. G. M. Lewis, R. E. Azuma, E. Gabathuler, D. W. G. S. Leith, and W. R. Hogg (Glasgow Univ.). Phys. Rev., 125: 378-84(Jan. 1, 1962).

The variation of the differential cross section for π^+ photoproduction from hydrogen, with γ-ray energy, was examined at a laboratory angle of 58° to the γ-ray beam. A thin hydrogen target, and a counter system designed to eliminate random events, were employed. Mean values for the differential cross section $d\sigma/d\Omega$ at γ-ray energies of 162, 168, 175, and 192 Mev are 5.42 ± 0.38, 5.77 ± 0.41, 6.74 ± 0.47, and 8.22 ± 0.58 μb/sr, respectively, where the error limits refer to relative values. The results substantiate the rising trend of the interaction quantity $\{(d\sigma/d\Omega)(\mu^2/p\epsilon)(1 + \omega/M)^2\}$ near the threshold, in accord with dispersion theory; and the absolute cross sections are compatible with a threshold value for α_3^+ near 20 μb/steradian, consistent with findings in related pion work. (auth)

8132 GAUGE INVARIANCE AND MASS. Julian Schwinger (Harvard Univ., Cambridge, Mass. and Univ. of California, Los Angeles). Phys. Rev., 125: 397-8 (Jan. 1, 1962).

It is argued that the gauge invariance of a vector field does not necessarily imply zero mass for an associated particle if the current vector coupling is sufficiently strong. This situation may permit a deeper understanding of nucleonic charge conservation as a manifestation of a gauge invariance, without the obvious conflict with experience that a massless particle entails. (auth)

8133 COUNTER TECHNIQUES IN HIGH ENERGY NUCLEAR PHYSICS: RARE DECAYS OF π- AND μ-MESONS. A. W. Merrison. Proc. Phys. Soc. (London), 78: 1116-24 (Dec. 1, 1961).

It is shown, with particular reference to the decay $\mu^+ \rightarrow e^+ + \gamma$, how the study of rare decays of pions and muons, by means of counter techniques, contributes to understanding the weak interactions. (auth)

8134 A MEASUREMENT OF THE TOTAL CROSS SECTION FOR THE PRODUCTION OF NEUTRAL PIONS IN PROTON-PROTON COLLISIONS AT 383 Mev. A. Astbury,

M. A. R. Kemp, H. Muirhead, R. G. P. Voss, and T. Woodhead (Univ. of Liverpool). Proc. Phys. Soc. (London), 78: 1151-6(Dec. 1, 1961).

A value of (59 ± 9) μb was obtained for the total cross section for the production of π^0 in p-p collisions at 383 Mev. (auth)

8135 LOW ENERGY ELASTIC SCATTERING OF NEUTRONS BY DEUTERONS. J. W. Humberston (University Coll., London). Proc. Phys. Soc. (London), 78: 1157-62(Dec. 1, 1961).

Neutron-deuteron scattering phases are evaluated at 5 energies below 8 Mev for two ranges of a central Yukawa interaction. The dependence of the phases on the range is found to be very slight. Considerable differences are found betweeen these results and those given by Haas and Robertson (Proc. Roy. Soc. A 73, 160(1959)) who used the same form of interaction. The shorter of the two ranges is considered. Results and subsequent discussion resolve previously inexplicable differences between the scattering lengths obtained with potential shapes. (auth)

8136 CHARACTERISTIC ELECTRON ENERGY LOSS SPECTRA OF THE NOBLE METALS AND THEIR NEIGHBOURS. J. L. Robins (Univ. of Western Australia, Nedlands). Proc. Phys. Soc. (London), 78: 1177-87(Dec. 1, 1961).

The characteristic electron energy-loss spectra Zr, Pd, Ag, Au, Zn, and Cd were obtained using the reflection technique and primary electron energies of 1500 and 800 ev. It is observed that in the second group of transition metals, the relation between the observed plasma losses and the theoretical values is not quite the same as that found previously for the first group of transition metals, in that the observed values are greater than the theoretical near the beginning of the series. The spectra of the noble metals are complex and show few similarities. Zn and Cd, following noble metals in the periodic table, have similar spectra, and plasma oscillations involving their two valence electrons are still influenced by the recently-filled d band. (auth)

8137 THE EFFICIENCY OF PRODUCTION OF CHARACTERISTIC X-RADIATION IN THICK TARGETS OF A PURE ELEMENT. M. Green and V. E. Cosslett (Cambridge Univ., Eng.). Proc. Phys. Soc. (London), 78: 1206-14(Dec. 1, 1961).

A theoretical expression is proposed for K quanta production in directions at large angles to the surface of a thick target, neglecting absorption. Direct and indirect production are calculated and the ratio of indirect to total production is shown to be in agreement with experimental results in magnitude and in independence of over-voltage U_0. Total production is expressed as a function of atomic number Z and over-voltage U_0, and varies as $(U_0 - 1)^{1.67}$. Values for total production are in fair agreement with experimental values. (auth)

8138 ON A MODEL OF NUCLEON STRUCTURE AND MESON–NUCLEON INTERACTION. [PART] II. Hiroshi Nakamura (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto), 26: 431-52(Oct. 1961). (In English)

The elastic and inelastic widths of the second and third resonances of π-nucleon collision are calculated. Though some parts of this calculation could be translated to that of Takeda's ρ-meson theory, it is shown that the elastic width depends on the corresponding ρ-nucleon wave function. The ρ-π coupling constant $F^2/4\pi$ is estimated to be $1 \sim 2$ from the experimental value of the inelastic width. The two-ion exchange ρ-nucleon potential is calculated. It is attractive in the second region ($0.7\mu^{-1} \leq r \leq 1.5\mu^{-1}$) and strong enough to construct ρ-nucleon bound states. As a straightforward application of the model, 5–Bev π-nucleon scattering is analyzed. This analysis gives a ρ-meson mass of 5 to 6μ and ρ-π coupling constant about 3. (auth)

8139 ON VERTICAL REPRESENTATION OF BETHE-SALPETER AMPLITUDES. Masakuni Ida and Kazumi Maki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 470-82(Oct. 1961). (In English)

The Bethe-Salpeter equation for S-wave bound states of two scalar particles with equal mass interacting via scalar mesons is considered in the ladder approximation. It is shown that an integral representation holds for all the solutions, normal and abnormal, of the B-S equation. Use is made of the fact that the B-S equation under consideration can be written in a form of an integral equation with a real symmetric and positive kernel. Also given is a limitation on the lowest eigenvalue of such an integral kernel in terms of its first and second traces. (auth)

8140 OBSERVABLES OF A DIRAC PARTICLE. P. M. Mathews and A. Sankaranarayanan (Univ. of Madras). Progr. Theoret. Phys. (Kyoto), 26: 499-504(Oct. 1961). (In English)

The most general forms, consistent with reasonable physical requirements, for the position and other observables of a Dirac particles are obtained. (auth)

8141 ON A RADIATIVE DECAY OF Σ^+. Makoto Sawamura (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 26: 505-18(Oct. 1961). (In English)

The radiative decay of Σ^+ is examined using a dispersion-theoretic method. The matrix element is related to those of the pion photoproduction from proton and the ordinary Σ^+ decay in the lowest mass approximation. In order to obtain the real part of the matrix element, according to Fujii-Iwata's rule the parameter reflecting the damping behavior of the decay matrix element corresponding to the increase of Q-values is introduced. Concerning the effective interaction of $\Sigma^+ \rightarrow n^0 + \pi^+$, the conventional type, i.e., $a^+ + b^+\gamma_5$, was introduced. Examining the results in the light of the observed decay rate, it is concluded that b^+ may be excluded in some accuracy. (auth)

8142 EFFECTS OF THE γ-3π INTERACTION ON THE ELECTROMAGNETIC PROPERTIES OF DEUTERON. Yasunori Fujii (Nihon Univ., Tokyo) and Masaaki Kawaguchi. Progr. Theoret. Phys. (Kyoto), 26: 519-40(Oct. 1961). (In English)

Effects of the γ-3π interaction on the electromagnetic properties of the deuteron are examined by making use of the effective interaction Hamiltonian suggested from the isoscalar part of the electromagnetic form factors of the nucleon. The contribution of the γ-3π interaction to the magnetic moment of the deuteron is unreasonably large, namely comparable with the observed value, although this result depends strongly on the inner part of the deuteron wave function and the pion dissociation probability of the nucleon. The electric quadrupole moment due to the γ-3π interaction is about 20% of the observed value. The γ-3π interaction also contributes to the photodisintegration of the deuteron through the M1 and E2 transitions with the $^3S + {}^3D$ final state. The interference term between the usual E1 term and that herein contributes appreciably to an asymmetry in the angular distribution. (auth)

8143 Kπ RESONANCE EFFECT TO THE FORM FACTORS IN THE K_{l3} DECAYS. Jugoro Iizuka (Univ. of Chicago). Progr. Theoret. Phys. (Kyoto), 26: 554-64 (Oct. 1961). (In English)

The form factors in the leptonic three-body decays of

K mesons are studied in terms of the dispersion-theoretic techniques developed by Goldberger and Treiman (Phys. Rev. 110: 1178(1958)). Assuming that the Kπ resonance has a dominant contribution to the dispersion integral, it is shown that the consequences of the partially conserved current hypothesis follow from the theory under the weaker conditions on the high energy behavior of the divergence of the current. (auth)

8144 SOME NOTES ON THE EFFECTS OF VECTOR MESON ON THE ELECTROMAGNETIC STRUCTURE OF NUCLEON. Reijiro Kubo and Hiroshi Nakamura (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto), 26: 565-7 (Oct. 1961). (In English)

Results of studies on the ρ-meson mass and the small ρ-π coupling constant (K. Itabashi et al, Progr. Theoret. Phys. 24: 529(1960)) are compared with the nucleon electromagnetic structure theory. They are found to be consistent. (L.N.N.)

8145 EVIDENCE FOR QUADRATIC SPIN-ORBIT INTERACTION. N. R. Yoder and Peter Signell (Pennsylvania State Univ., University Park). Progr. Theoret. Phys. (Kyoto), 26: 567-8(Oct. 1961). (In English)

Static potential shapes were investigated. Results account for p-p singlet even-parity data and support the hypothesis of a proposed quadratic spin-orbit term (T. Hamada, Progr. Theoret. Phys. 24: 1033(1960)). (L.N.N.)

8146 NOTE ON K^--p INTERACTIONS AT 400 Mev/c. Shigeo Minami (Osaki City Univ.). Progr. Theoret. Phys. (Kyoto), 26: 569-72(Oct. 1961). (In English)

It is shown that interference between $p_{1/2}$ and $p_{3/2}$ states is mainly responsible for the angular distributions of K^--p interactions at 400 Mev/c. The reactions $K^- + p \rightarrow \pi^0 + \Sigma^0$ and $K^- + p \rightarrow K^- + p$ are considered. The p and d wave interactions are discussed. (L.N.N.)

8147 DISPERSION RELATIONS IN NUCLEON-NUCLEON SCATTERING AND RESONANCES IN MANY-PION SYSTEM. Yasuo Hara (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 26: 627-46(Nov. 1961). (In English)

The two-pion contribution to the absorptive part of the forward nucleon-nucleon scattering amplitude in the unphysical region is calculated numerically using the Cini-Fubini approximation. The magnitude of the contribution to the absorptive part from multi-pion (three and more-pion) intermediate states is evaluated from the relations used as sum rules and it is found that a resonance appears either in the T = 0, J = 1, odd parity state (neutral vector boson) or in the T = 0, J = 0, odd parity state (neutral pseudoscalar boson) or in both states of the multi-pion system. If the resonance is caused by a neutral vector boson with 3-pion mass, the magnitude of the rationalized $f^2/4\pi = 1.2$. (auth)

8148 ON $\pi + N \rightarrow Y + \pi + K$ REACTION. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 26: 647-58(Nov. 1961). (In English)

The reaction $\pi + N \rightarrow Y + \pi + K$ at high energy is studied by taking into account the effects of Y^* and K^*. Since the isotopic spins of Y_1^*, Y_0^* and K^* seem to be equal to 1, 0 and $\frac{1}{2}$ respectively, it may be expected that, for example, $\pi^- + p \rightarrow \Sigma^0 + \pi^- + K^+$ and $\pi^- + p \rightarrow \Sigma^+ + \pi^- + K^0$ take place mainly through the processes $\pi^- + p \rightarrow \Sigma^0 + K^* \rightarrow \Sigma^0 + \pi^- + K^+$ and $\pi^- + p \rightarrow Y_0^* + K^0 \rightarrow \Sigma^+ + \pi^- + K^0$ respectively. The cross sections and angular distributions of $\pi + N \rightarrow Y^* + K$ and $\pi + N \rightarrow Y + K^*$ processes are examined, and the effects due to Y^* are compared with those due to K^*. (auth)

8149 NONSTATIC ONE-BOSON-EXCHANGE POTENTIALS. Norio Hoshizaki, I Lin, and Shigeru Machida (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 26: 680-92(Nov. 1961). (In English)

Nonstatic one-boson-exchange potentials between two nucleons are listed. The potentials are obtained exactly in the momentum space. In the coordinate space they are given up to the order M^{-2} in the M^{-1} expansion. (M is the nucleon mass). (auth)

8150 NON-STATIC EFFECTS IN THE NUCLEON-NUCLEON INTERACTION. Philip Connors and Peter Signell (Pennsylvania State Univ., University Park). Progr. Theoret. Phys. (Kyoto), 26: 757-60(Nov. 1961). (In English)

A numerical method was used to solve the momentum space integral equation for the scattering amplitude. The complete one-pion-exchange potential (OPEP) phase shifts were computed and compared with the static OPEP phases. The nonstatic part of OPEP was found to be insignificant for $^1D_2$ at moderate energies. (auth)

8151 A NOTE ON THE NON-LEPTONIC DECAY MODES OF THE Ξ-HYPERON. A. P. Balachandran and K. Venkatesan (Univ. of Madras). Progr. Theoret. Phys. (Kyoto), 26: 792-3(Nov. 1961). (In English)

A pole approximation calculation for the decay mode $\Xi \rightarrow \Lambda + \pi$ is presented. It is suggested that the patterns of Σ-decay asymmetries arises because α_Σ and α_Λ have opposite signs. The K_1^0-K_2^0 mass difference is calculated in the pole approximation. (L.N.N.)

8152 THREE-PION RESONANCE AND HIGH ENERGY PHENOMENA. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 26: 801-3(Nov. 1961). (In English)

Mesons (ω) produced in $\bar{p}$-p interactions are considered. The isotopic spin of the 3-π resonant ω is 0 and the mass is about 790 ± 20 Mev. The ω may also be regarded as a resonant state in the ρ-π system, where ρ indicates the resonant state in the π-π system with a mass of 750 Mev, isotopic spin I = 1, and spin j = 1. The resonant state in which ω corresponds to a neutral vector meson is derived from current field theory. The K^--p interaction is discussed. Effects of ω on π-N interactions are also considered. (L.N.N.)

8153 PROTON-ANTIPROTON COLLISION AND ISOBARIC STATES. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 26: 803-6(Nov. 1961). (In English)

Branching ratios for the reaction $p + \bar{p} \rightarrow K + K^- + \pi + \pi$ are examined to determine modifications resulting when either substate plays the more important role. Discussions as to the relative importance of the substates are presented. The isobaric states in π-K, π-N, π-Λ, and π-Σ systems are considered. (L.N.N.)

8154 ON THE PROPERTIES OF THE ELECTRON BEAM IN THE PRESENCE OF AN AXIAL MAGNETIC FIELD OF ARBITRARY STRENGTH. Hans Wilhelmsson. Trans. Chalmers Univ. Technol., Gothenburg, No. 205, 1-31(1958). (In English)

Effects of an axial magnetic field of arbitrary strength on wave propagation in an electron beam are studied. It is assumed that the d-c current and d-c electron densities are constant over the beam cross section and uniform in the beam's axial direction and that the electron beam is infinitely long and of cylindrical shape. All a-c quantities are assumed to be small in comparison with corresponding static quantities. Collisional effects are neglected. Angular asymmetrical modes are considered. Attention

is given to the drift Lorentz terms and to relativistic corrections. Current density a-c components are calculated. Coupled differential equations are obtained for the axial field components. Information on existence of types of waves available for excitation and on interactions is also obtained. Electron beam wave propagation properties are described using the wave functions. Finally, a propagation coefficient equation of waves excitable in the beam is obtained. (L.N.N.)

8155 THE INTERACTION BETWEEN AN OBLIQUELY INCIDENT PLANE ELECTROMAGNETIC WAVE AND AN ELECTRON BEAM. PART III. Hans Wilhelmsson. Trans. Chalmers Univ. Technol., Gothenburg, No. 206, 1-17(1958). (In English)

In the presence of an infinitely strong axial magnetic field, a one-to-one correspondence between previously plotted resonances (H. Wilhelmsson, Report No. 32, Res. Lab. of Electronics, Chalmers Univ. of Technology (1954)) and possible angular symmetrical modes of longitudinal space charge waves of the beam is found. For a large ratio between external and internal dielectric constants, a spectrum of angular asymmetrical space charge waves excitable using an obliquely incident plane electromagnetic wave is found. No space charge waves excitable in the beam are found in the absence of a magnetic field. The beam acts like a metallic reflector provided the axial phase velocity of the incident wave equals the beam velocity and the magnetic field vector of the incident wave is polarized perpendicularly to the beam. Explicit expressions are obtained for the current density and electron velocity a-c components. Resonances corresponding to longitudinal and transverse space charge wave excitation are expected in scattering in the presence of axial magnetic fields. (L.N.N.)

Neutron Physics

8156 (ANL-6459) TRANSPORT SOLUTIONS TO THE ONE-DIMENSIONAL CRITICAL PROBLEM. George J. Mitsis (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-eng-38. 36p.

An expansion method for treating the one-velocity transport equation is applied to a uniform, one-dimensional multiplying medium. The method leads to exact expressions for the neutron distribution and criticality conditions. These expressions depend on expansion coefficients which are shown to satisfy a Fredholm integral equation. The results of diffusion theory with the exact Milne problem extrapolation distance are shown to correspond to the zeroth-order approximation of the Neumann series solution to the Fredholm equation. (auth)

8157 (DC-58-6-221) NEUTRON SLOWING DOWN MODEL USING DIRECT PROPORTIONS—TASK 7176. J. D. Popp (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 24, 1958. Contract AT (11-1)-171. 14p.

Programming of a method is described for obtaining a slowing down neutron fraction for various computed lethargy levels. The program is written in CAGE for the IBM 704 digital computer. The program can be used to compute a slowing down neutron fraction for an infinite homogeneous reactor. The homogeneous mixture may contain up to five elements. (auth)

8158 (DC-60-11-51) SOME THEORETICAL NOTES ON THE TRANSMISSION AND ABSORPTION OF NEUTRONS BY FINITE CYLINDRICAL RODS. T. J. Kostigen (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 1957. Contract AT(11-1)-171. 53p.

An attempt was made to determine the spatial and energy distribution of neutron flux within the reactor and adjacent media assuming the fuel element to be a lattice cell consisting of a cylindrical rod of fissile material passing along the moderator. The mathematical formulation of the problem is presented. Calculations for cosine angular entrance distribution, leakage or streaming of neutrons, source distributions on end surfaces of a homogeneous cylinder, and calculations for cosine squared angular entrance distribution are discussed. (M.C.G.)

8159 (IDO-16718) RESONANCE INTEGRAL REPRESENTATIONS. R. G. Nisle (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 20, 1961. Contract AT(10-1)-205. 18p.

The usual resonance integral representations are referred to some lower cut-off energy determined by a cadmium filter. Such representations are unsatisfactory for two reasons: the cut-off energy varies with the geometry and thickness of the filter used, and the whole system is worthless in the case of isotopes having resonance at or close to cut-off energies. A satisfactory resonance integral representation can be derived by abandoning the cadmium filter concept and substituting the concept of a Maxwellian and a non-Maxwellian reaction rate. The resulting representation utilizes the effective cross section index $P_x(F_1,T)$ and the conventional flux of Westcott. The proposed formulation leads to a system, definable in terms of measurable quantities, that is self-consistent, that is consistent with the usual representation, and that can be used for any absorber. (auth)

8160 INFLUENCE OF COLLIMATION ON THE ENERGY SPECTRUM OF 2.7 Mev NEUTRONS. B. Antolković, M. Paić, M. Turk, and D. Winterhalter (Institute "Ruder Bošković," Zagreb and Faculty of Sciences, Zagreb). Glasnik mat.-fiz. i Astron., Ser. II, 16: 135-41(1961). (In English)

Collimators of iron or paraffin were tested. Shield walls of paraffin were used. The shield block had a 30 × 30-cm square opening. Neutrons at 2.7 Mev were obtained in the $D(d,n)He^3$ reaction at 200 kev. Results indicated that the fast-neutron peak, well-defined at the smaller aperture of the collimator, becomes less distinct at larger apertures. A better defined spectrum is obtained by increasing the collimator length. The thickness of the shield decreases the number of scattered neutrons reaching the detector. By increasing the amount of iron in the compound collimator, the fast-neutron peak in the spectrum becomes less sharp. (L.N.N.)

8161 DIFFUSION LENGTH OF A CRYSTALLINE POWDER, AND DISTORTION OF THE MAXWELL SPECTRUM. A. Herpin and D. Saint James (Center d'Etudes Nucleaires, Saclay, France). J. phys. radium, 22: 193-203(Apr. 1961). (CEA-1730). (In French)

A calculation of the neutron diffusion length in a crystal is developed. The difference of mean free path between the neutrons of wave length greater than the first Bragg wave length and the neutrons of a smaller wave length is taken into account. This calculation allows an indirect determination of the absorption cross section. The calculation also shows that the Maxwell distribution suffers a deformation. The calculation is applied to the case of beryllium and beryllium oxide. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 8068 and 8071

8162 (ARF-1193-6) SCINTILLATION SPECTROMETER MEASUREMENTS OF CAPTURE GAMMA RAYS FROM NATURAL ELEMENTS. Second Quarterly Report, September 15, 1961 to December 14, 1961. Reginald C. Greenwood (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 9, 1962. Contract AT(11-1)-578. 76p.

A compilation was made of neutron capture gamma ray spectra of naturally occurring elements, covering both the low and the high energy spectral region, using NaI(Tl) scintillation detectors. An external beam from the ARF research reactor is being used as a source of thermal neutrons for this compilation. Improvements were made to the detection system and experiments were conducted to determine the most suitable crystal sizes to obtain the low energy (less than approximately 1 Mev) capture spectra. To expedite energy calibrations in this low energy region, a set of secondary energy standards were produced from the rhodium and samarium capture spectra; the cadmium capture spectrum is a primary energy standard. Low energy capture gamma ray spectra of scandium, cobalt, rhodium, silver, cadmium, indium, dysprosium, holmium, thulium, ytterbium, lutetium, rhenium, and gold were obtained using the 3" × 3" NaI(Tl) detector. Many previously unreported lines were observed in these spectra. (auth)

8163 (DC-59-3-25) NEUTRON CROSS SECTIONS IN BERYLLIUM-9. T. J. Kostigen (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 15, 1959. Contract AT(11-1)-171. 28p.

A compilation is presented of the present knowledge of Be^9 cross sections for neutrons in the energy range from 0.5 to 14 Mev. Perhaps most notable is the amount of data on the differential elastic scattering cross section that is collected together. On the other hand, measured data on the (n,2n) reaction is scanty. As a consequence, certain calculations were made in an attempt to predict the energy distribution of the outcoming neutrons from this reaction since this appears to be an important question in reactor design work. In addition to the cross sections themselves, the derived quantities, average loss in the logarithm of the energy and average cosine of the laboratory scattering angle in elastic scattering collisions, were computed by making use of the differential scattering information. The results show a considerable variation of these quantities with neutron energy. (auth)

8164 (DC-59-10-135) U^{235} FISSION PRODUCT DECAY GAMMA ENERGY SPECTRA. M. A. Capo (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 9, 1959. Contract AT(11-1)-171. 28p.

Compiled in graphical form are recently calculated U^{235} fission product decay gamma energy spectra. These spectra are grouped into seven energy ranges. Reactor operating times of 0.25, 1, 3, 10, 30, 100, 300, and 1000 hours are included. Spectra are plotted for each energy group as a function of time after shutdown ranging from 1.67×10^2 seconds to 100 days. (auth)

8165 (DC-60-9-75) GAMMA RAY CROSS SECTION DATA. R. A. Mann (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 7, 1960. Contract AT(11-1)-171. 79p.

Photoelectric, pair production, Compton, and total gamma ray cross sections are tabulated for various energies ranging from 0.01 to 10 Mev. Data for several elements, mixtures, and compounds are presented. Also tabulated as a function of energy are the ratios of the Compton cross section to the total cross section. In addition, the Compton scattering cross section, reduced to a normalized cumulative density function for various energy groups, is included for use in the flexible Monte Carlo program (FMC-G). (auth)

8166 (DC-60-9-76) FAST NEUTRON DOSE RATE CALCULATIONS INCORPORATING ENERGY DEPENDENCE OF DETECTOR RESPONSE. K. B. Hanchon (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 12, 1960. Contract AT(11-1)-171. 11p.

A method is given for incorporating a functional fit to the energy dependence of the detector response in fast neutron dose rate calculation using an influence function of the Albert-Welton type. Tables giving a comparison of the functional fit with published tabulated values are included, as well as calculations of the GE-ANPD Source Plate water centerline fast neutron dose rate and the ORNL-BSR water centerline fast neutron dose rate. (auth)

8167 (NP-11174) ELECTRIC DIPOLE GROUND STATE TRANSITION WIDTH STRENGTH FUNCTION AND 7 MEV PHOTON INTERACTIONS. Technical Report No. 30. Peter Axel (Illinois. Univ., Urbana. Physics Research Lab.). Nov. 1961. Contract ONR 1834(05). 54p.

Formulas are given describing significant effects that a Porter-Thomas distribution of ground-state transition widths would have on the interpretation of the nuclear interaction of photons which reach closely spaced but separated energy levels. When these formulas are used to reinterpret existing data, the parameters implied by photon interaction become consistent with those resulting from neutron capture data. These compatible parameters are further shown to be consistent with a crude generalized extrapolation of the giant dipole resonance. At energies near 7 Mev, the average photon absorption cross section can be written approximately as: $\langle\sigma_a\rangle = 5.2\ \text{mb}(E/7\text{Mev})^3 \times (A/100)^{\frac{5}{3}}$. This extrapolation also implies a ground-state transition width strength function which does not have the $E^2A^{\frac{2}{3}}$ dependence usually used because of single particle model predictions. Near 7 Mev, $\langle\Gamma_0\rangle/D = 2.2 \times 10^{-5}$ $(E/7\ \text{Mev})^5\ (A/100)^{\frac{5}{3}}$; below 3 Mev, $\langle\Gamma_0\rangle/D = 6.7 \times 10^{-6}$ $(E/1\ \text{Mev})^4\ (A/100)^{\frac{5}{3}}$. These estimates, while subject to refinements, are in better accord with experiments than are the more popular single particle estimates. (auth)

8168 (NP-11239) THE NUCLEAR PROPERTIES OF RHENIUM. Quarterly Technical Progress Report No. 8, September 8, 1961 through December 8, 1961. R. A. Karam and T. F. Parkinson (Florida. Univ., Gainesville). Contract NOas 60-6021-c. 12p.

The cadmium ratios of gold, indium, and rhenium foils were measured as a function of foil thickness. Gold was used as a standard and indium served as a secondary standard. The activation resonance integral of natural rhenium was found to be 694 ± 28 barns. (auth)

8169 (TID-14569) CALCULATION OF NUCLEAR PARAMETERS FOR ZIRCONIUM. D. T. Goldman and C. R. Lubitz (Knolls Atomic Power Lab., Schenectady, N. Y.). [1961]. Contract [W-31-109-Eng-52]. 4p.

Paper to be presented at the New York APS Meeting, January 24-27, 1962.

Calculations were made to find optical model parameters which would fit the differential cross section for neutron scattering by zirconium. The contribution of the compound process to the elastic scattering was also calculated. It is concluded that there is an isotopic effect in natural zirconium and that it may be necessary to perform elastic scat-

tering measurements on separated zirconium isotopes. (D.L.C.)

8170 (UCRL-9872) NUCLEAR ALIGNMENT EXPERIMENTS ON CERIUM RADIOISOTOPES (thesis). James Norman Haag (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 29, 1961. Contract W-7405-eng-48. 120p.

Submitted to Univ. of California.

Nuclei of Ce^{137m}, Ce^{137}, Ce^{139}, Ce^{141}, and Ce^{143} were aligned in a neodymium ethylsulfate lattice at low temperatures by the magnetic hyperfine-structure method. The angular distribution and the plane polarization of the emitted gamma rays were measured as functions of temperature. For the spin sequence $11/2(Ce^{137m}) \xrightarrow[255\ kev]{M^4} 3/2(Ce^{137})$, the magnetic moment of Ce^{137m} is $|\mu_N| = 0.96 \pm 0.09$ nm. The spin of Ce^{137m} was established as 11/2. For the spin sequence $3/2(Ce^{137}) \xrightarrow{i_\beta=0^+} 3/2 \xrightarrow[445\ kev]{M1,\ E2} 5/2$, the magnetic moment of Ce^{137} is $|\mu_N| = 0.95 \pm 0.20$ nm and δ (E2/M1) = -0.17 ± 0.02. The beta transition was established as predominantly $i_\beta = 0$. For the spin sequence $3/2(Ce^{139}) \xrightarrow{i_\beta=1} 5/2 \xrightarrow[166\ kev]{M1,\ E2} 7/2(La^{139})$, the magnetic moment of Ce^{139} is $|\mu_N| = 0.95 \pm 0.20$ nm and δ (E2/M1) = $+0.034 \pm 0.034$. For the spin sequence $7/2(Ce^{141}) \xrightarrow{i_\beta=0^+} 7/2 \xrightarrow[142\ kev]{M1,\ E2} 5/2(Pr^{141})$, the magnetic moment of Ce^{141} is $|\mu_N| = 1.30 \pm 0.20$ nm and δ (E2/M1) = $+0.066 \pm 0.022$. The spin of the 142-kev level of Pr^{141} was established as 7/2. The β transition was established as predominantly $i_\beta = 0$. (auth)

8171 (UCRL-9882) ATOMIC BEAM STUDIES: HYPERFINE-STRUCTURE SEPARATIONS IN POTASSIUM-42, RUBIDIUM-84, AND CESIUM-129; MAGNETIC MOMENT AND HYPERFINE-STRUCTURE ANOMALY IN POTASSIUM-42 (thesis). Jhan M. Khan (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 6, 1961. Contract W-7405-eng-48. 93p.

The atomic beam flop-in magnetic resonance method is used to measure the hyperfine-structure splitting ($\Delta\nu$), and the magnetic moment (μ_I) in one case, of K^{42}, Rb^{84}, Cs^{127}, and Cs^{129}. The electronic ground state is $^2S_{1/2}$. From the $\Delta\nu$ and μ_I of K^{42} it is possible to determine the K^{42} hyperfine-structure anomaly with respect to K^{39}, K^{40}, and K^{41}. (auth)

8172 SEMI-CLASSICAL DESCRIPTION OF HIGH-ENERGY ELECTRON SCATTERING ON HEAVY NUCLEI. A. Frenkel (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Hung., 13: 321-31(1961). (In English)

WKB phase-shift formulas for high energy electron scattering by heavy nuclei are derived. Ranges of validity are discussed. The phase-deviation upper boundary and the relative error of the differential cross section are considered. (L.N.N.)

8173 DELAYED NEUTRON YIELDS FROM THE FISSION OF Pu^{239} AND Th^{232} INDUCED BY 14.5-Mev NEUTRONS. V. I. Shpakov, K. A. Petrzhak, M. A. Bak, S. S. Kovalenko, and O. I. Kostochkin. Atomnaya Energ., 11: 539-40(Dec. 1961). (In Russian)

Previous measurements indicated that in the fission of U^{235} induced by 2.4-, 3.3- and 14.5-Mev monoenergetic neutrons, the delayed neutron yield remains unchanged up to 3.3 Mev and at 14.2 Mev it is increased by a factor of 2; similar observations were made with the even nuclei of U^{238} and Th^{232}. This made it of interest to study the delayed neutron yield of the fission of Pu^{239} and Th^{232} with 14.5-Mev neutrons, defining the delayed neutron yield as the ratio of delayed neutrons generated in 1 sec to the total number of fissions in the same period. The Cd-clad Pu or Th targets were exposed to a 14.5-Mev neutron flux from the $T(d,n)He^4$ reaction, using B counters in a paraffin block as detectors. The total yield was found to be 0.0130 ± 0.0015 for Pu^{239} and 0.075 ± 0.007 for Th^{232}. The latter figure agrees well with previously published data. The Pu^{239} yield is increased by a factor of 2 when the 14.5-Mev neutrons are used; this is attributed to the increased probability of neutron emission by a given nucleus. (TTT)

8174 THE KINETIC ENERGY OF FRAGMENTS FROM THE PHOTOFISSION OF Th^{232}. B. A. Bochagov, A. P. Komar, G. E. Solyakin, and V. I. Fadeev. Atomnaya Energ., 11: 540-3(Dec. 1961). (In Russian)

Study of the kinetic energy of fission fragments makes it possible to determine the most probable mass ratio m_2/m_1 which then can be compared with the radiochemically determined ratio. As such radiochemical data are available for the fragments from the photofission of Th^{232}, the corresponding kinetic energy distribution values were determined by means of a method originally developed for studying the photofission of U^{238} (E. A. Bochagov et al., Zhur. Eksper. i Teoret. Fiz. 38, 1374 (1960)). A Th nitrate preparation on an aluminized collodion film was used as the target of the γ-ray source. The data obtained indicated that the most probable value of the m_2/m_1 ratio is 1.56 which agrees well with the radiochemically obtained value of 1.52 (D. Hiller and D. Martin, Phys. Rev. 90, 581 (1953)). The energy distribution curve of the fragments indicates that the total energy is lower and the half-width of the maximum of the spectrum is larger than the corresponding values of the photofission of U^{238}. (TTT)

8175 ELASTIC AND INELASTIC SCATTERING OF PROTONS BY Be^9 IN THE ENERGY REGION FROM 6.1 TO 7.3 Mev. Ryutaro Ishiwari (Kimura Lab., Japan). Bull. Inst. Chem. Research, Kyoto Univ., 39: 287-312(Nov. 1961). (In English)

Angular distributions of proton elastic and inelastic scattering leading to the 3.04, 2.43, and 1.75-Mev states in Be^9 were measured at 6.1 to 7.3 Mev. The background subtraction was carried out giving attention to the 3.04-Mev state. No remarkable energy dependence of angular distributions is seen for the elastic scattering. All angular distributions of inelastic scattering show distinct forward peaks and change little with the proton energy. In the angular distributions for the 2.43-Mev state gradual but definite energy dependence can be recognized. These angular distributions are compared with the simple direct interaction theories. Results are consistent with the negative parity of the 3.04-Mev state and the positive parity of the 1.75-Mev state. Cross sections for the excitation of the 3.04, 2.43 and 1.75-Mev states are 22, 106, and 5 mb respectively, for 7.3-Mev protons. Inelastic scattering leading to these states in Be^9 occurs mainly via direct interaction process, and the contribution from the compound nucleus formation is small in the present energy region. (auth)

8176 THE PHASE SHIFT ANALYSIS ON ALPHA-ALPHA SCATTERING IN THE ENERGY RANGE FROM 22.9 TO 28.9 Mev. Kozo Miyake (Kimura Lab., Japan). Bull. Inst. Chem. Research, Kyoto Univ., 39: 313-21 (Nov. 1961). (In English)

Alpha scattering by helium was studied experimentally with increased accuracy at five energies between 22.9 and 28.9 Mev. The phase shift analysis up to L = 6 was performed for each energy. The result shows that the S-, D- and G-wave phase shifts are necessary to fit the data and the I-wave phase shift is small in this energy range. Level parameters for the G-state were extracted using the dispersion theory, and are compatible with the alpha-alpha model of Be^8. (auth)

8177 RESONANCES OF THE V^{51} (p,n) Cr^{51} REACTION. Eizo Teranishi, Bunji Furubayashi, Misao Kageyama, Taichi Michikawa, and Yajiro Inoue (Electrotechnical Lab., Tokyo). Denki Shikensho Ihô, 25: 695-9(Sept. 1961). (In English)

The neutron yield from the $V^{51}(p,n)Cr^{51}$ reaction was measured and 71 incompletely resolved peaks were observed in the proton energy range from 1.67 to 2.05 Mev. The γ yield from the $V^{51}(p,\gamma)Cr^{52}$ reaction was also measured simultaneously with the neutrons, and some of the γ peaks were more obvious than the neutron peaks at the same energy. Strong γ resonances were observed at E_p = 1.559, 1.565, and 1.629 Mev. The average value of $\sigma(p,\gamma)$-to-$\sigma(p,n)$ ratio is of a order of 0.05 above E_p = 1.63 Mev, suggesting predominant s-wave and p-wave formations and decays of many of the resonance levels in Cr^{52} in this proton energy region. (auth)

8178 THE OBSERVATION OF THE DECAY OF B_5^9 IN A NUCLEAR EMULSION. V. F. Darovskikh, M. M. Makarov, and V. I. Ostroumov (Khlopin Radium Inst., Academy of Science, USSR). Doklady Akad. Nauk S.S.S.R., 141: 593-4(Nov. 21, 1961). (In Russian)

Four cases were observed where a multicharged particle decays into 3 charged particles. By comparing tracks it was found that the charge of the original particle is 5 or 6. The secondary particles are two alpha particles and one proton. Since momentum is conserved, it can be assumed that a neutron is not formed as a secondary particle. The possibility of elastic scattering of a B_5^9 particle by a hydrogen nucleus was eliminated. It is believed that B_5^9 breaks down as follows: $B_5^9 \rightarrow Be_4^8 + p$, since the energies of the alpha particles are almost equal. The excitation energies of the B_5^9 nucleus were found to be 2.3, 2.9 and 5.0 Mev. The decay of B_5^9 goes to the first excited level of Be_4^8 (the 2.9-Mev level with a width of about 1 Mev) and not to the ground state of Be_4^8, probably because of the great difference in spins between Be_4^8 and the ground state of Be_4^8. It is assumed that the B_5^9 is formed by the beta decay of C_6^9, especially since the trace of a fast electron was found in one of the stars. (TTT)

8179 ON THE DEVIATIONS FROM THE ALLOWED SHAPE IN THE ALLOWED β-DECAY SPECTRA. B. Eman and D. Tadic (Institute "Ruder Bošković," Zagreb). Glasnik mat.-fiz. i Astron., Ser. II, 16: 89-120(1961). (In English)

Deviations from the allowed shape are discussed, and correction factors for the spectrum and longitudinal polarization are calculated including possible high-order correction. Allowed β decay is separated into the groups $\log ft \approx 3$, $3 < \log ft < 5$, and $\log ft \approx 6$. The β-decay interaction Hamiltonian is modified; the nonrelativistic Hamiltonian constructed with all possible combinations of available operators invariant under the 3-dimensional rotation group is used. Nuclear matrix elements for mirror and $0^+ \rightarrow 0^+$ β transitions are calculated on the basis of the shell model. The 1-forbidden transitions, with large ft values, are discussed in detail; experiments are suggested. A list of transitions classified as such is provided. (L.N.N.)

8180 INELASTIC SCATTERING OF 2.7 Mev NEUTRONS BY ^{27}Al. PRELIMINARY NOTE. Dragica Winterhalter (Univ. of Zagreb and Institute "Ruder Bošković," Zagreb). Glasnik mat.-fiz. i Astron., Ser. II, 16: 131-4 (1961). (In English)

The energy spectrum of neutrons inelastically scattered by Al^{27} were measured at 90 and 120° angles to the incident neutron beam. The neutrons were obtained in $D(d,n)He^3$ reactions at up to 200 kev. A peak resulting from elastic scattering corresponded to energies of 2.56 Mev at 90° and 2.47 Mev at 120°. (L.N.N.)

8181 NOTE ON HYPERFINE INTERACTION TENSORS IN ESR SPECTRA. Jan W. H. Schreurs (National Research Council, Ottawa) and Daniel Kivelson. J. Chem. Phys., 36: 117-18(Jan. 1962).

A theory of linewidths in the ESR spectra of radicals with several interacting equivalent nuclei is developed for the case in which the total nuclear spin angular momentum for the entire group of interacting nuclei is not a good quantum number. (auth)

8182 PHOTON SCATTERING ON ATOMS AND NUCLEI IN CRYSTALS. C. Tzara (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 303-7(May 1961). (CEA-1805). (In French)

Photon scattering by atoms and nuclei in solids is investigated. Depending on the excited (nuclear or atomic) state width compared to the crystal vibration spectrum, the proportion of recoilless scattering varies between two limits: the Debye-Waller factor and the square of the Mössbauer-Lamb factor. Interference between the two processes is examined. Finally the recoilless emission of a nuclear photon following a sequence of transitions is calculated without calling upon a rearrangement phenomenon in the solid. (auth)

8183 ANALYSIS OF BETA SPECTRUM OF Rh^{106}. Chen-yueh Mei (Mai) and Hung Yuan Su. K'o Hsüeh Tung Pao, No. 2, 55(1959).

An analysis is made of the beta spectrum of Rh^{106} by the method of expansion after Fermi. Four components with energies at 4.64, 3.56, 2.51, and 1.82 Mev and relative intensities 0.78, 70.6, 18.4, and 10.2% are observed. (Referat. Zhur. Fiz., 7: 16384(1960)).

8184 THE REACTION SILICON-29(n,α) MAGNESIUM-26 AT 14 MEV NEUTRON ENERGY. W. M. Deuchars and G. P. Lawrence (Australian National Univ., Canberra). Nature, 192: 1278-9(Dec. 30, 1961).

A 400 Ω cm n-type silicon surface barrier detector was irradiated with neutrons at 14.03 ± 0.05 Mev. The reaction $Si^{29}(n,\alpha)$ Mg^{26} has a Q-value of −0.022 Mev, but it is possible to observe the reaction in competition with the more intense silicon-28 reactions. An approximate cross-section ratio was obtained for the Mg^{26} ground state and 1.801 Mev excited state groups. The spectrum of the reaction is given. (P.C.H.)

8185 THEORY OF NUCLEAR EXCITATIONS BY MUONS IN HEAVY MESIC ATOMS. D. F. Zaretski and V. M. Novikov (Kurchatov Atomic Energy Inst., Academy of Sciences, Moscow). Nuclear Phys., 28: 177-91(1961). (In English)

A study is made of the electromagnetic nuclear excitation by muons in heavy mesic atoms (radiationless excitation). An expression for the probability of this process is obtained. The change of the nuclear fission barrier caused by a muon in the K-shell is calculated. The theory is compared with experiment. (auth)

8186 PAIRING FORCES AND PAIR CORRELATIONS IN Pb^{206}, Pb^{210} AND Po^{210}. V. N. Guman, Yu. I. Kharitonov, L. A. Sliv, and G. A. Sogomonova (Leningrad Inst. of Physics and Tech.). Nuclear Phys., 28: 192-209(1961). (In English)

Pairing forces acting between nucleons in a nucleus are studied. Nuclei with two identical nucleons (holes) over the closed shells are investigated for this purpose. Both

pairing interaction and the nucleon interaction with the surface of the nuclear core are taken into account by diagonalizing the energy matrix. The need of evaluating pair correlation for non-zero values of I is shown. The sensitivity of the pairing potential to different physical characteristics of nuclei is studied. The energy levels up to 3 Mev are obtained for the Pb^{208}, Pb^{210}, and Po^{210} nuclei and the transition probabilities calculated. (auth)

8187 PAIRING FORCES AND PAIR CORRELATION IN Tl^{206} AND Bi^{210}. Yu. I. Kharitonov, L. A. Sliv, and G. A. Sogomonova (Leningrad Inst. of Physics and Tech.). Nuclear Phys., 28: 210-19(1961). (In English)

The residual pairing forces between a neutron and proton in a nucleus are determined. The calculated energies, eigenfunctions, and transition probabilities in Tl^{206} and Bi^{210} are compared with experiment. (auth)

8188 ON THE DISPERSION THEORY OF DIRECT NUCLEAR REACTIONS. I. S. Shapiro (Theoretical and Experimental Physics Inst., Academy of Sciences, Moscow). Nuclear Phys., 28: 244-57(1961). (In English)

The Feynman graphs with singularities closest to the physical region of variables are assumed to be responsible for the main contribution to the amplitude of a direct nuclear process. Using the dispersion relations with respect to energy a singular integral equation is obtained for calculating interactions in the initial and final states. This equation admits an accurate solution and simple iteration, the first-order iteration corresponding to the method of distorted waves. It is found that a substantial contribution to the direct process mechanism may come not only from pole graphs corresponding to the Butler mechanism, exchange stripping, and heavy pick-up reactions, but from more complex graphs as well. The reaction $Be^9(d,n)B^{10}$, $Be^9(\alpha,t)B^{10}$, and $C^{12}(d,p)C^{13}$ are considered to illustrate this point. Some reactions of the type (x,yz) and in particular, the "knock-out" of nuclear clusters, are also analyzed. (auth)

8189 A STUDY OF SOME APPROXIMATIONS OF THE PAIRING FORCE. J. Hoegaasen-Feldman (Laboratoire de Physique Nucléaire, Orsay, France and Univ. of Copenhagen). Nuclear Phys., 28: 258-69(1961). (In English)

The quasi-particle and boson approximations are used in the study of the first 0+ excited state of the pairing force. A special case is chosen, which allows a quantitative study of the validity of these approximations. This validity shows a strong dependence on the coupling constant, and on the degeneracy of the shell-model levels. (auth)

8190 THEORY OF COLLECTIVE EXCITATIONS OF SPHERICAL NUCLEI WITH PARTICULAR APPLICATION TO THE GIANT DIPOLE STATE. Jerzy Sawicki and Toshio Soda (Univ. of California, Berkeley). Nuclear Phys., 28: 270-92(1961). (In English)

The system of equations of motion for the components of the one-particle density matrix is linearized, for a finite system of fermions interacting through a two-body "residual" force. Exchange terms are included. Equations corresponding to those of the "extended shell model" method are obtained for calculating collective states of spherical nuclei of definite angular momentum, parity, spin, and isobaric spin, in both the j-j and L-S coupling schemes. Particular application and solution of such equations is obtained for the case of the giant dipole state of O^{16} by the use of finite range potentials with two different mixtures of exchange forces and radial shapes. The matrix elements are antisymmetrized and the "backward-going graphs" are included. The left-over terms bilinear in the density operator are then "minimized" by extracting their lowest order linear contribution. The resulting correction terms are estimated for the giant dipole state in O^{16} and found to be small, giving support to the Random Phase Approximation. (auth)

8191 EXCITATION OF THE 15.1 Mev LEVEL OF C^{12} BY INELASTIC SCATTERING OF PROTONS AT 150 Mev. X. de Bouard, H. Langevin-Joliot, N. Marty, and B. Tatischeff (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). Nuclear Phys., 28: 293-303(1961). (In French)

The excitation of the 15.1 Mev level of C^{12} ($J^\pi = 1^+$, T = 1) by 150-Mev protons is studied. The angular distribution of the scattered protons in coincidence with the de-excitation γ rays emitted in the recoil direction of the nucleus is determined. The angular correlation between inelastically scattered protons and γ rays is measured at a scattering angle of 8°. (auth)

8192 STRIPPING OF HEAVY PROJECTILES. M. El Nadi and H. Sherif (Cairo Univ.). Nuclear Phys., 28: 331-41(1961). (In English)

The theoretical differential cross sections for the multiple stripping processes of heavy projectiles are given. Comparison with experimental data is given for He^3-, He^4-, and Li^6-nuclei projectiles. In some cases an isotropic contribution from the compound nucleus mechanism is introduced to improve agreement with experimental data. (auth)

8193 ANGULAR CORRELATIONS IN STATISTICAL NUCLEAR REACTIONS. V. M. Strutinskii (Strutinski) (Kurchatov Atomic Energy Inst., Academy of Sciences, Moscow). Nuclear Phys., 28: 342-52(1961). (In English)

The angular correlation of particles emitted consecutively by a nucleus of high angular momentum is considered. Simple analytical expressions are obtained for the angular correlation of two particles under the condition that the final nucleus remains in a state of low momentum. Consideration is also given to particle-fragment angular correlation. (auth)

8194 POSSIBLE NUCLEAR STRUCTURE EFFECTS IN Lu^{175}. J. E. Thun (Univ. of Uppsala), Z. Grabowski, M. S. El-Nesr, and G. Bruce. Nuclear Phys., 29: 1-12(1962).

Electron-gamma, gamma-electron, and gamma-gamma angular correlations in Lu^{175} were measured. Results are: $A_2(282\gamma - 114\gamma) = 0.240 \pm 0.004$, $A_2(282\gamma - 114K) = 0.02 \pm 0.01$, and $A_2(282K - 114\gamma) = 0.015 \pm 0.030$. No perturbation, due to quadrupole interaction, was found. Conversion coefficients were determined from coincidence and single counting rates: $\alpha_K(114) = 1.6 \pm 0.3$; $\alpha_K(282) = 0.030 \pm 0.007$. The result of the $282K - 114\gamma$ angular correlation measurement is greatly diminished from normal. This may be understood in terms of the presence of penetration matrix elements in the conversion process of the retarded 282-kev E1 + M2 transition. The measured K-conversion coefficients show no deviation from the tabulated values. (auth)

8195 ANGULAR CORRELATION MEASUREMENTS IN Hf^{177}. J. E. Thun, Z. Grabowski, W. D. Hamilton, and M. S. El-Nesr (Univ. of Uppsala). Nuclear Phys., 29: 13-20(1962). (In English)

Gamma-gamma, electron-gamma, and gamma-electron angular correlations of the 208 to 113-kev cascade in Hf^{177} were measured. Results are: $A_2(208\gamma - 113\gamma) = -0.143 \pm 0.003$, $A_2(208\gamma - 113K) = 0.000 \pm 0.008$, and $A_2(208K - 113\gamma) = 0.200 \pm 0.035$. The angular correlation

between the K-conversion electrons of the retarded 208-kev E1 transition and 113-kev gamma was normal. (auth)

8196 ANGULAR CORRELATION AND RESONANT SCATTERING IN ^{117}Sn. W. D. Hamilton, Z. Grabowski, and J. E. Thun (Univ. of Uppsala). Nuclear Phys., 29: 21-32(1962). (In English)

Electron-gamma and gamma-gamma correlation measurements were made of the decay cascade in Sn^{117m}. The following correlation coefficients were determined: $A_2(159\gamma - 161\gamma) = -0.146 \pm 0.010$, $A_2(159K - 161\gamma) = -0.160 \pm 0.008$. These confirm the M4(159 kev) and M1 (161 kev) multipolarities, and indicate that both transitions are essentially pure. The resonant scattering condition for the 161-kev γ was provided by the thermal method. Matched tin and cadmium scatterers were used, and the resonant cross section was determined relative to that for Rayleigh scattering. The total mean-life of the 161-kev level has the value $\tau = (1.6 \pm 0.5) \times 10^{-10}$ sec, and corresponds to a hindrance factor of 24 ± 8 for the l-forbidden M1 transition. (auth)

8197 DECAY OF Sm^{153} TO Eu^{153}. T. Suter, P. Reyes-Suter, S. Gustafsson, and I. Marklund (Inst. of Physics, Uppsala). Nuclear Phys., 29: 33-65(1962). (In English)

The decay of Sm^{153} to Eu^{153} was investigated using an iron yoke double focusing spectrometer, gamma-gamma and electron-gamma coincidence spectrometers. A precision measurement of the 69.672-kev line was performed using an iron-free double focusing spectrometer. Internal conversion lines and photo-electric lines of the following transitions were measured and their energies determined with a precision of a few parts in 10^4: 69.672; 75.34; 83.37; 89.47; 97.45; 103.174; ≈ 104.8; 172.85 kev. Conversion electron and gamma intensities, multipolarities, mixing ratios and conversion coefficients are given. Using the photo-electron method, 16 other weak transitions were measured with a resolution of 0.5% to 0.25%: 151.5; 411.5; 424.3; 437.7; 449.7; 463.6; 521.3; 531.4; 533.2; 539.1; 555.2; 578.6; 596.9; 603.1; 609.1; 636.0 kev. Difficulties in the computation of intensities of low energy gamma rays from external conversion measurements are discussed. A decay scheme is proposed on the basis of the energy data and a quantitative analysis of the gamma-gamma and electron-gamma coincidences. Excited levels at the following energies were established: 83.37; 97.45; 103.17; 172.85; (191.4); 634.6; 636.4; (694.3); (706.4) kev. (auth)

8198 HALF-LIFE MEASUREMENTS OF Tl^{204} AND Ag^{110m}. Ragnar Nilsson (Aktiebolaget Atomenergi, Studsvik, Sweden). Nuclear Phys., 29: 66-9(1962). (In English)

The decay of Tl^{204} and Ag^{110m} was followed for 2.3 and 1.2 yr. The half lives are (3.91 ± 0.09)yr and (249 ± 3)d, respectively. Possible effects of the recently detected Ag^{108m} isotope on the determination of the half life of Ag^{110m} were considered. Additional measurements gave a value for the Ag^{110m} activation resonance integral of (38 ± 8)barns.

8199 ANGULAR CORRELATION STUDIES OF THE 326, 405 AND 630 KEV $Al^{27}(p,\gamma)$ RESONANCES. John I. Valerio and Edward B. Nelson (State Univ. of Iowa, Iowa City). Nuclear Phys., 29: 70-88(1962). (In English)

The $Al^{27}(p,\gamma)Si^{28}$ reaction at the 326, 405, and 630-kev resonances was investigated. The gamma spectra were studied with large NaI scintillators and a three-crystal scintillation pair spectrometer, while decay schemes and relative intensities were determined by coincidence techniques. Angular correlation studies, (p,γ) and (p,γ,γ), established the spin and parity of the first two excited states in Si^{28}, 1.78 and 4.62 Mev, as 2^+ and 4^+, respectively, and of the proton capture states: 11.90, 4^-; 11.98, 4^-; and 12.20 Mev, 3^-. A weak cascade branch, observed at the 405-kev resonance, proceeds through the 8.59 and 1.78 Mev levels. Correlation studies on this cascade are in agreement with a spin and parity assignment of 3+ for the 8.59 Mev level. (auth)

8200 THE T = 1 EXCITED STATES OF C^{12}. N. Vinh-Mau (Universite de Paris, Orsay, France), and G. E. Brown. Nuclear Phys., 29: 89-99(1962). (In English)

The T = 1 states of C^{12} are calculated within the particle-hole formalism, and the results are compared with experiment. Calculations are carried out both with and without ground-state correlations. The approximation of zero-range forces is used. In addition to reproducing known levels, the calculations indicate that the strong level at 19.5 Mev is 2-, and that a higher dipole level, not yet observed, exists at 34 Mev. (auth)

8201 THE CHARACTER OF THE 1315 KEV STATE IN Yb^{174}. H. J. Prask, J. W. Bichard, E. G. Funk, Jr., and J. W. Mihelich (Univ. of Notre Dame, Ind.). Nuclear Phys., 29: 100-8(1962). (In English)

The electron capture decay of Lu^{174} populating levels of 76.5 and 1315 kev in Yb^{174} was re-investigated. A measurement of the K-conversion coefficient of the 1238 ±7-kev transition was made, and a directional correlation measurement performed on the 1238 to 76.5-kev cascade. The data were consistent with an assignment of 2^- for the 1315-kev level in Yb^{174}. (auth)

8202 THE TWO-NUCLEON STRIPPING REACTION. Norman K. Glendenning (Univ. of California, Berkeley). Nuclear Phys., 29: 109-19(1962). (UCRL-9505). (In English)

Expressions for the angular distribution of the (α,d) reaction are derived. Explicit coupling schemes for even, odd-mass and odd target nuclei in the j-j limit are used to define the nuclear structure factors. (auth)

8203 (α,d) REACTIONS ON ODD TARGETS. Joseph Cerny, Bernard G. Harvey, and Richard H. Pehl (Univ. of California, Berkeley). Nuclear Phys., 29: 120-36(1962). (UCRL-9525). (In English)

The reactions $Li^6(\alpha,d)Be^8$ and $N^{14}(\alpha,d)O^{16}$ were studied using 48 Mev helium ions. Deuteron angular distributions were obtained for energy levels in the final nuclei. They, as well as distributions for the reaction $C^{12}(\alpha,d)N^{14}$ previously studied, are compared with angular distributions calculated from the two-nucleon stripping theory. The integrated cross sections for formation of levels of Be^8 and O^{16} are discussed in terms of the spectroscopic states of these nuclei. (auth)

8204 LEVELS IN Gd^{156} FED IN THE β-DECAY OF Eu^{156}. G. T. Ewan, R. L. Graham, and J. S. Geiger (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Phys., 29: 153-76(1962). (In English)

The disintegration scheme of Eu^{156} was studied using the Chalk River high-resolution β spectrometer, scintillation spectrometers and coincidence techniques. The internal conversion electron spectrum was studied at momentum resolution settings in the range 0.02 to 0.08%. Conversion lines were observed corresponding to 28 γ-transitions in Gd^{156} of energies in kev: 88.97 (E2), 199.19 (E2), 599.5 (E1), 646.3 (E1), 709.9, 723.5, 811.8 (M1), 865.8, 867.1 (E1), 960.8 (E1), 1040.5, 1049.5, 1065.1 (E2), 1079.2, 1153.4 (E1), 1154.0 (E2), 1168.5, 1230.7 (E1), 1242.4 (E1), 1277.4, 1366.4 (E1), 1876.8 (M1, E2), 1937.5 (M1, E2), 1965.8 (M1, E2), 2026.4 (M1, E2), 2097.8 (M1, E2), 2181.0 (M1, E2) and 2186.8 (M1, E2). The multipolarity assignments for the two

lowest energy transitions were deduced from the L subshell conversion line intensity ratios; the others are based on the K-conversion coefficients deduced in this work. The β spectrum of Eu^{156} has at least four components of energies 2430 ± 10 (33%), 1195 ± 15 (14%), 485 ± 20 kev (36%) and a low energy component of <350 kev (≈17%). A β-γ coincidence experiment shows that the 2430-kev component feeds the ground state of Gd^{156}. Considerations of gamma energy sums and γ-γ coincidence experiments establish levels in Gd^{156} at energies in kev of 0(0+), 88.97 (2+), 288.16 (4+), 1154.0 (2+) 1242.4 (1−), 1319.7, (2−), 1366.4 (1−), 1965.8 (1,2+), 2026.4 (1,2+), 2181.0 (1,2+) 2186.8 (1,2+) and 2203.4 (0,1,2+). Most of the low spin levels in Gd^{156} fed in the β-decay of Eu^{156} (0) were not observed in the electron capture decay of Tb^{156}(3,4−). (auth)

8205 PROTONS FROM ^{32}S BOMBARDED BY 14.4 Mev NEUTRONS. B. Antolković (Institute "Rudjer Boskovic," Zagreb). Nuovo cimento (10), 22: 853-5(Nov. 16, 1961). (In English)

The energy spectrum and angular distributions of protons emitted in neutron reactions (n,np) with S^{32} at 14.4 Mev were determined using a photographic plate method. Nuclear plates allow measurements of low-energy protons, and it becomes possible to estimate the nuclear temperature of the reaction. (L.N.N.)

8206 THE ANALYSIS OF (d,p) STRIPPING REACTIONS BY THE DISTORTED WAVE BORN APPROXIMATION. B. Buck and P. E. Hodgson (Clarendon Lab., Oxford). Phil. Mag. (8), 6: 1371-84(Nov. 1961).

Formulas giving the differential cross section for a (d,p) stripping reaction, the polarization of the outgoing proton, and the angular correlation between it and the gamma ray from the residual nucleus are summarized for the distorted-wave Born approximation. Methods of programming this calculation for an electronic computer are described, and results of check calculations are given. (auth)

8207 NUCLEAR SPIN-LATTICE RELAXATION IN SUPERCONDUCTING ALUMINUM. Yoshika Masuda and A. G. Redfield (International Business Machines Corp., New York). Phys. Rev., 125: 159-63(Jan. 1, 1962).

The nuclear spin-lattice relaxation time of superconducting aluminum was measured from 0.35°K to the critical temperature. The method used was that of Hebel and Slichter; low temperatures were attained through the use of a He^3 cryostat. The estimated energy gap is 3.2 kT_c, in agreement with microwave measurements. The data are in good agreement with the predictions of Hebel and Slichter based on the Bardeen, Cooper, and Schrieffer theory of superconductivity. The data indicate a smearing or width of the BCS energy levels which decreases with increasing temperature and is approximately 1/10 of the energy gap at all temperatures. (auth)

8208 Ti^{47} AND Ti^{49} HYPERFINE STRUCTURE IN THE ELECTRON SPIN RESONANCE OF TITANIUM(III) COMPLEXES. Edward L. Waters and August H. Maki (Harvard Univ., Cambridge, Mass.). Phys. Rev., 125: 233-4(Jan. 1, 1962).

Satellite lines were resolved in the solution electron spin resonance spectra of two complexes of titanium (III). These lines arise from hyperfine interaction of the unpaired electron with the odd isotopes of titanium, Ti^{47} and Ti^{49}. The nuclear spins of the two isotopes are found to be $^5/_2$ and $^7/_2$, respectively, in agreement with earlier nuclear induction intensity measurements. The Ti hyperfine constants for the two complexes are almost identical (50.0 Mc/sec). The two complexes studied are a one-to-one complex between titanium (III) and the OCH_3^- ion, and the TiF_2^+ ion. The preparation of these complexes is discussed. In the case of the TiF_2^+ ion, an additional hyperfine interaction is observed with the two fluorine nuclei. The splitting constant for the fluorine interaction is 21.1 Mc/sec. The optical spectra of these complexes show large splittings of the d-electron levels which are believed to the the result of strong axial perturbations by the coordinating ligands. These splittings lengthen the electron spin lattice relaxation time sufficiently to permit the resolution of the satellite lines. (auth)

8209 HYPERFINE STRUCTURE AND NUCLEAR MOMENTS OF RaE(Bi^{210}). Seymour S. Alpert, Edgar Lipworth, Matthew B. White, and Kenneth F. Smith (Univ. of California, Berkeley). Phys. Rev., 125: 256-61(Jan. 1, 1962). (UCRL-9729)

The magnetic-dipole interaction constant, a, and the electric-quadrupole interaction constant, b, were measured for 5-day Bi^{210} (I = 1) in an atomic-beam experiment. The results are |a| = 21.78 ± 0.03 Mc/sec and |b| = 112.38 ± 0.03 Mc/sec, with b/a = + 5.160 ± 0.007. The nuclear magnetic-dipole and electric-quadrupole moments obtained from the interaction constants are $|\mu|$ = 0.0442 ± 0.0001 nm and |Q| = 0.13 ± 0.01 barn, respectively. The signs of these moments are not determined by the experiment. The ordering of the hyperfine levels is F = $^1/_2$, $^5/_2$, and $^3/_2$. The values of the hyperfine level separations are $\Delta\nu$(F = $^5/_2$ ↔ F = $^3/_2$) = 194.93 ± 0.09 Mc/sec, $\Delta\nu$(F = $^3/_2$ ↔ F = $^1/_2$) = 220.19 ± 0.08 Mc/sec. (auth)

8210 NUCLEAR LEVEL SPLITTING CAUSED BY A COMBINED ELECTRIC QUADRUPOLE AND MAGNETIC DIPOLE INTERACTION. Eckart Matthias (Univ. of Uppsala), Werner Schneider, and Rolf M. Steffen. Phys. Rev., 125: 261-8(Jan. 1, 1962).

The interaction of a static electric field gradient and a static magnetic field with the electromagnetic moments of a nucleus is considered in detail. The eigenvectors and eigenvalues of the interaction Hamiltonian are computed as a function of the angle β between the electric field gradient and magnetic field directions, and as a function of the electric and magnetic interaction parameters ω_E and ω_H. Numerical calculations of the eigenvectors and eigenvalues were performed for nuclear spin values I = 1, $^3/_2$, 2, $^5/_2$, 3, $^7/_2$, 4, and $^9/_2$ and for a wide range of the parameters β, ω_E, and ω_H. The accuracy of the results is 0.001%. Representative numerical results are presented. (auth)

8211 ANALYTICAL SOLUTIONS FOR VELOCITY-DEPENDENT NUCLEAR POTENTIALS. M. Razavy, G. Field, and J. S. Levinger (Louisiana State Univ., Baton Rouge). Phys. Rev., 125: 269-72(Jan. 1, 1962).

The two-nucleon potential, with the necessary invariance requirements, is assumed to be a quadratic function of momentum: $v = -V_0J_1(r) - (\lambda/M)\, p \cdot J_2(r)p$, where $J_1(r)$ and $J_2(r)$ are two short-range functions. For simplicity $-J_2(r)$ is assumed to be a square well of unit depth. The Schrödinger equation is solved (neglecting Coulomb forces) for three different choices of $J_1(r)$. Numerical results for the phase shifts are given for these three potentials (ν_1, ν_2, and ν_3) for the singlet S, D, and G states. Reasonably good fits are obtained. (auth)

8212 VELOCITY-DEPENDENT NUCLEAR POTENTIALS FOR SINGLET-EVEN STATES. O. Rojo and L. M. Simmons (Louisiana State Univ., Baton Rouge). Phys. Rev., 125: 273-5(Jan. 1, 1962).

The usual models for the two-nucleon interaction involve a potential which includes a repulsive hard core at short distances and as a result, the treatment of the many-body problem is mathematically complicated. Peierls, Levinger,

and others suggested that ordinary perturbation theory may be useful if the two-body interaction can be described by a well-behaved potential. Such a description of the singlet-even states in terms of a potential of the form $-V_0J(r) + (\lambda/M)[p^2\omega(r) + \omega(r)p^2]$. $J(r)$ and $\omega(r)$ are well-behaved functions of the relative separation and p is the operator for the relative momentum. The effective range and zero-energy scattering length along with the ^1S, ^1D, and ^1G phase shifts in the energy range 20 to 340 Mev are calculated and adjusted to fit the experimental values. The low energy parameters and the ^1S phase shifts fit very well. Agreement with the ^1D and ^1G phase shifts is plausible but less satisfactory. Suggestions for improving the fit are made. The treatment is nonrelativistic and Coulomb effects are ignored. (auth)

8213 ANOMALOUS NEUTRON SCATTERING OF Ar^{36}. R. E. Chrien, A. P. Jain, and H. Palevsky (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 275-6(Jan. 1, 1962). (BNL-5645)

The thermal neutron scattering of argon is unusual in that it shows a large amount of incoherent scattering, even though it is even-even and practically monoisotopic. The incoherence was ascribed by Henshaw to a large scattering cross section for Ar^{36}. Measurements with the BNL fast chopper for a gas sample enriched to 63% Ar^{36} show that the total cross section from 0.1 ev to 6 kev varies in such a way as to reveal the presence of a negative energy level. The parameters $\Gamma_n^0 = 82$ ev, $E_0 = -9.8$ kev, and $\Gamma_\gamma = 1.85$ ev are deduced for this level. The consequences of this anomalous scattering for neutron studies of atomic motions in a liquid are discussed. (auth)

8214 ELASTIC SCATTERING OF 24-MEV NEUTRONS BY Al, Fe, Sn, Bi. T. P. Stuart, J. D. Anderson, and C. Wong (Univ. of California, Livermore). Phys. Rev., 125: 276-9(Jan. 1, 1962). (UCRL-6352)

Angular distributions were measured for angles between 15 and 90° in 5° steps. Cylindrical scatterers were $\frac{1}{2}$ or $\frac{3}{4}$ mean-free path in diameter as calculated on the basis of total cross sections. These cylinders were bombarded with neutrons from the $T(d,n)He^4$ reaction, and the scattered neutrons were detected in a plastic scintillator. Biases were set at energies between 14 and 24 Mev. Corrections for effects due to scatterer size were calculated with a Monte Carlo code on the Univac and IBM 704. The corrected cross sections are in good agreement with optical model calculations by Bjorklund and Fernbach. (auth)

8215 EXCITATION CURVES FOR REACTIONS OF ALPHA PARTICLES WITH C^{12} FROM 15 TO 19 MEV. R. D. Carpenter, L. R. Mentillo, and E. Bleuler (Purdue Univ., Lafayette, Ind.). Phys. Rev., 125: 282-3(Jan. 1, 1962).

Exploratory measurements of 4.43-Mev gamma from the reaction $C^{12}(\alpha,\alpha')C^{12*}$ and of the total cross section for the reaction $C^{12}(\alpha,n)O^{15}$ for incident energies between 15 and 19 Mev are reported. The two excitation curves appear somewhat anticorrelated, the maxima of the O^{15} yield occurring at 15.5, 16.6, 17.3, and 18.5 Mev, those of the gamma-ray yield at 15.9 and 18.0 Mev. There is no evident correlation between these curves and the differential (α,p) cross section reported by Priest, Tendam, and Bleuler (NSA, 14: 13214). (auth)

8216 NUCLEAR SPIN, HYPERFINE STRUCTURE, AND NUCLEAR MOMENTS OF 64-HOUR YTTRIUM-90. F. Russell Petersen and Howard A. Shugart (Univ. of California, Berkeley). Phys. Rev., 125: 284-91(Jan. 1, 1962).

The atomic-beam magnetic-resonance method was used to measure the nuclear spin and hyperfine-structure separations of 64-hour Y^{90}. The results are $I = 2$, $a(^2D_{5/2}) = -169.749(7)$ Mc, $b(^2D_{5/2}) = -21.602(27)$ Mc, $a(^2D_{3/2}) = -85.258(6)$ Mc, $b(^2D_{3/2}) = -29.716(38)$ Mc. The uncorrected nuclear moments calculated from these measurements are $\mu_I = -1.623(8)$ nm, $Q = -0.155(3)$ b. (auth)

8217 (p,n) CROSS SECTIONS ON Ti^{47}, V^{51}, Cr^{52}, Co^{59}, AND Cu^{63} FROM 4 TO 6.5 MEV. H. Taketani and W. Parker Alford (Univ. of Rochester, N. Y.). Phys. Rev., 125: 291-4(Jan. 1, 1962).

Absolute (p,n) cross sections were measured for Ti^{47}, V^{51}, Cr^{52}, Co^{59}, and Cu^{63} at energies between 4 and 6.5 Mev. These data plus earlier measurements of the cross section for inelastic proton scattering have been used to estimate total proton absorption cross sections for V^{51} and Co^{59}. An optical model calculation using parameters giving a good fit to elastic scattering measurements predicts an absorption cross section in good agreement with the measurements for Co^{59}. For V^{51}, some sets of parameters gave good agreement with the measured absorption cross section, but the fit to the elastic scattering data was only fair. (auth)

8218 SEPARATION OF THE FINAL STATES OF THE RESIDUAL NUCLEUS IN THE PICKUP REACTION $C^{12}(p,d)C^{11}$ AT 154 MEV. Pierre Radvanyi, Jeannie Genin, and Claude Detraz (Faculte des Sciences, Orsay, France). Phys. Rev., 125: 295-6(Jan. 1, 1962).

The deuteron groups corresponding to different states of C^{11} in the (p,d) reaction on C^{12} at 154 Mev were separated with a magnetic analyzer. A comparison with the known levels of C^{11} shows that only the $^3/_2-$ and $^1/_2-$ states (prominently the $^3/_2-$ ground state) seem to be formed to an appreciable extent. These results can be explained by the fact that at this energy the pickup of a more loosely bound high-momentum p-shell neutron should be the most probable; the observed states of C^{11} would then correspond mainly to a hole created in the p shell of C^{12} in its ground state. This gives the possibility in high-energy pickup reactions of exciting selectively certain states of the residual nucleus. (auth)

8219 SOME CROSS-SECTION LIMITS FOR THE OCCURRENCE OF THE (n,He^3) REACTION AT 14.5 MEV. E. T. Bramlitt, R. W. Fink, D. G. Gardner, and A. Poularikas (Univ. of Arkansas, Fayetteville). Phys. Rev., 125: 297-301(Jan. 1, 1962).

The (n,He^3) reaction at 14.5 ± 0.9 Mev was investigated with scintillation spectroscopy and radiochemical techniques. No case of an (n,He^3) reaction could be detected at this energy. Upper limits were set on the (n,He^3) cross section for the following target nuclides: $Mg^{26}(3.0)$, $Al^{27}(0.70)$, $P^{31}(0.25)$, $K^{41}(2.5)$, $V^{51}(0.33)$, $Mn^{55}(0.42)$, $Co^{59}(0.10)$, $Cu^{63}(0.08)$, $As^{75}(0.51)$, $Zr^{94}(0.4)$, $Rh^{103}(0.09)$, and $Cs^{133}(0.15)$, where the value in parentheses is the upper limit in millibarns. One case of the $(n,n'\alpha)$ reaction was detected at this energy, on Cu^{65} with a cross section of a few millibarns. (auth)

8220 RADIATIVE PROTON CAPTURE IN O^{18}. John W. Nelson and Emmett L. Hudspeth (Univ. of Texas, Austin). Phys. Rev., 125: 301-6(Jan. 1, 1962).

The excitation function for radiative proton capture in O^{18} was observed at zero degrees with a 3-in. × 3-in. NaI crystal. Bias adjustments were selected in order to establish the resonances for proton capture which lead to the emission of high-energy radiation. About twenty resonances were found for protons ranging in energy from 1.6 to 3.0 Mev, and there were indications for a number of weaker

additional resonances. A slow-coincidence technique was used to investigate the gamma decay schemes for F^{19} for six levels of excitation from 8.56 to 10.10 Mev. Quantitative conclusions are drawn regarding the decay of these levels to the ground "triplet" of F^{19}. (auth)

8221 NATURAL RADIOACTIVITY OF RHENIUM. Clarence J. Wolf and W. H. Johnston (Purdue Univ., Lafayette, Ind.). Phys. Rev., 125: 307-10(Jan. 1, 1962).

The natural radioactivity of Re^{187} was investigated by the method of internal gas-tube low-level Geiger counting. A half-life of $(1.2 \pm 0.4) \times 10^{11}$ yr was found for the direct beta decay. Gas-tube proportional measurements suggest a value of about 3 kev for the maximum beta energy. This value of the endpoint energy, the lowest known, suggests that it may be a Re atom and not the nucleus alone which is decaying. (auth)

8222 MEASUREMENT OF NUCLEAR TRANSITIONS WITH 10^{-20}-SEC HALF-LIVES AND THE SCATTERING CROSS SECTIONS OF UNSTABLE PARTICLES BY PROXIMITY SCATTERING. Raymond Fox (Univ. of California, Livermore). Phys. Rev., 125: 311-18(Jan. 1, 1962). (UCRL-6190)

Proximity scattering uses the particular form of a two-particle final-state interaction in a three-particle final-state system, in which the two interacting particles just prior to their interaction are free. Proximity scattering is the reaction in which an incident particle (0) strikes a target nucleus (1), forming a composite nucleus (2) which then decomposes into two particles (3) and (4). Particle (4) at some time later decays into two particles (5) and (6), whereupon particle (5) then interacts with particle (3). The separability in space of (5) and (3) and their scattering are analyzed in terms of wave packets. The lifetime of particle (4) and the (5-3) scattering cross section is shown to be obtainable from the (5-3) energy and angular correlation. Illustrative numerical examples are given. (auth)

8223 COMPARISON OF THE BETA-ALPHA ANGULAR CORRELATIONS IN THE Li^8 AND B^8 BETA DECAYS, AND THE CONSERVED VECTOR CURRENT THEORY. M. E. Nordberg, Jr., F. B. Morinigo, and C. A. Barnes (California Inst. of Tech., Pasadena). Phys. Rev., 125: 321-30(Jan. 1, 1962).

A comparison of the beta-alpha angular correlations of the beta decays of Li^8 and B^8 to the 2.90-Mev alpha-unstable level of Be^8 is made. The data were fitted to an angular correlation in the laboratory system of the form $W(\theta_{\beta\alpha}) = 1 + A \cos\theta_{\beta\alpha} + B \cos^2\theta_{\beta\alpha}$, where A and B were independently determined for the Li^8 and B^8 beta decays from measurements at $\theta_{\beta\alpha} = 0$, 90, and 180°. The coefficients A are due to the recoil of Be^{8*} and have the same sign for both beta decays. The coefficients B arise from the interference of forbidden vector matrix elements with the allowed axial vector matrix element and have different signs in the two decays. The correlation for the Li^8 decay was measured with average total beta energies, $W_\beta \simeq 5$, 8, and 11 Mev. Both A and B were found to be approximately linear in W_β. The correlation for the B^8 decay was measured only with average $W_\beta \simeq 11$ Mev. From the data with $W_\beta \simeq 11$ Mev, the difference of the coefficients, $B(Li^8) - B(B^8)$, equals $(0.0070 \pm 0.0012)W_\beta$. This result is compared with theoretical predictions based on the older Fermi and the newer conserved vector current theories of beta decay. The experiment agrees with the prediction of the latter theory. (auth)

8224 INTERACTION OF 3.7-MEV NEUTRONS WITH MEDIUM WEIGHT NUCLEI. D. W. Kent, S. P. Puri, S. C. Snowdon, and W. P. Bucher (Bartol Research Foundation, Swarthmore, Penna.). Phys. Rev., 125: 331-5(Jan. 1, 1962).

A beam of 3.7-Mev neutrons having an energy spread of 400 kev was used to measure the differential cross sections of calcium, potassium, germanium, selenium, and strontium. Nonelastic cross sections are obtained by subtracting integrated elastic cross sections from the total cross sections. In addition, measurements of the transmission for ten additional elements were made at this energy as part of a comparison of total cross sections with optical-model predictions for medium weight nuclei. (auth)

8225 RESONANT SCATTERING OF GAMMA RAYS FROM NUCLEAR LEVELS WITH A LINEAR ACCELERATOR. F. D. Seward (Univ. of California, Livermore). Phys. Rev., 125: 335-40(Jan. 1, 1962). (UCRL-5778)

Elements were irradiated with a high-intensity bremsstrahlung beam and a search was made for γ rays scattered from nuclear levels. A 6 × 5-in.-diameter NaI(Tl) crystal was used as the detector. Resonant scattering was seen from Li^6, B^{11}, C^{12}, O^{16}, Mg, and Si. Pulse-height spectra for γ rays scattered from each of these are shown. Application of these spectra to previous experiments in which level widths and branching ratios were calculated is discussed. Levels in B^{11}, C^{12}, and O^{16} were observed which were not seen previously with this technique. (auth)

8226 MAGNETIC OCTUPOLE MOMENTS OF AXIALLY SYMMETRIC DEFORMED NUCLEI. S. A. Williams (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev., 125: 340-6(Jan. 1, 1962).

The magnetic octupole moments of twenty odd-A nuclei whose energy levels are described by the axially-symmetric collective model in strong coupling were calculated. With but two exceptions, the predicted moments are of the same magnitude as or larger than the moments measured for seven nuclei. The model parameters were determined by fitting the measured values of the lower moments and transition probabilities. The assumption is made that the orbital gyromagnetic ratio for the odd nucleon is that of a free particle. Then from the total gyromagnetic ratio of the particle, which was determined from the measured magnetic dipole moment and M1 transition probabilities, the spin gyromagnetic ratio, g_s, was determined. With but one exception g_s was found to have a value between the free particle and pure Dirac particle values. (auth)

8227 EXPERIMENTAL STUDY OF THE $O^{17}(p,\alpha)N^{14}$ REACTION AND A CALCULATION OF THE RATE OF THIS REACTION IN THE CNO CYCLE IN STARS. Ronald E. Brown (California Inst. of Tech., Pasadena). Phys. Rev., 125: 347-58(Jan. 1, 1962).

An experimental measurement of the absolute cross section for the $O^{17}(p,\alpha)N^{14}$ reaction was carried out in the energy range from 490- to 1580-kev proton bombarding energy at a laboratory angle of 150°. Resonances were observed at proton energies of 518, 672, 747, 825, 927, 1096, 1101, 1247, 1274, and 1335 kev. Other lethal parameters were assigned where possible. The 747-kev resonance corresponds to a level in F^{18} at 6302-kev excitation which does not appear to have been previously reported. A calculation of the ratio O^{17}/O^{16} formed at equilibrium at temperatures in the CNO cycle in stars is made, and it is concluded that the terrestrial material which was processed in the CNO cycle underwent this processing at a temperature of about 17×10^{6}°K. (auth)

8228 OPTICAL-MODEL ANALYSIS OF HIGH-ENERGY NEUTRONS SCATTERED BY DEFORMED NU-

CLEI. E. Gary Corman (Univ. of California, Livermore). Phys. Rev., 125: 359-65(Jan. 1, 1962). (UCRL-6485)

Effects of target nuclear deformations upon high-energy differential elastic and rotational excitation cross sections for neutron scattering are investigated. An optical-model potential of cylindrically symmetrical ellipsoidal shape is used to represent the target nucleus. The deformed potential is first oriented parallel to each of the coordinate axes. The differential cross sections are evaluated and averaged over such orientations. Next, the potential is oriented at an arbitrary angle. The differential cross section is evaluated and averaged over all possible orientation angles. The foregoing averaged cross sections are compared with the cross sections obtained by assuming spherical nuclei for the cases of aluminum and lutetium. Third, differential cross sections with the simultaneous excitations of the target nucleus to higher rotational levels are investigated. Results of calculations are shown for a nucleus having the dimensions of lutetium in initial I = 0 and I = 7 spin states. Fourth, the cross section and polarization are investigated by assuming a spin-orbit interaction added to the central deformed potential. It is found that for an arbitrary nuclear orientation the polarization generally has a component parallel to the scattering plane. However, such a component vanishes upon averaging over orientations. (auth)

8229 THE NUCLEAR SCATTERING OF HIGH ENERGY PHOTONS. W. S. C. Williams, H. S. Caplan, and D. T. Stewart (The University, Glasgow). Proc. Phys. Soc. (London), 78: 1125-34(Dec. 1, 1961).

Photon scattering by carbon nuclei at 50 to 130 Mev was measured using a total absorption Čerenkov spectrometer and a counter telescope. The angular range investigated was 90° to 135°. Results were analyzed using a simple model of nuclear charge distribution with nucleon polarizability and indicate the presence of some magnetic dipole scattering. A dispersion relation is applied to check the validity of this model. (auth)

8230 THE DEPOLARIZATION OF NEGATIVE MUONS IN LIGHT ELEMENTS. A. Astbury, P. M. Hattersley, M. Hussain, M. A. R. Kemp, H. Muirhead, and T. Woodhead (Univ. of Liverpool). Proc. Phys. Soc. (London), 78: 1144-8(Dec. 1, 1961).

A measurement of the polarization retained by μ^- in light elements is described. For elements with spin 0 the μ^- retains about 17% of its initial polarization. (auth)

8231 CAPTURE RATES FOR NEGATIVE MUONS IN LIGHT ELEMENTS. A. Astbury, I. M. Blair, M. Hussain, M. A. R. Kemp, and H. Muirhead (Univ. of Liverpool). Proc. Phys. Soc. (London), 78: 1149-50(Dec. 1, 1962).

Measurements are reported on μ^- capture rates in light elements. Agreement with other experimental data is found, but a discrepancy between the calculated and experimental values of the capture rate in fluorine is noted. (auth)

8232 THE TRANSFER AND EXCHANGE TRANSFER OF NUCLEONS BETWEEN ^{16}O AND ^{27}Al. R. F. Coleman and J. L. Perkin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 78: 1163-8(Dec. 1, 1961).

Cross sections for reactions with 36-Mev O^{16} ions were measured: neutron transfer, $Al^{27}(O^{16}, O^{15})Al^{28}$, ≤ 7 μb; proton transfer, $Al^{27}(O^{16}, F^{17})Mg^{26}$, 210 ± 50 μb; neutron-proton exchange transfer, $Al^{27}(O^{16}, F^{16})Mg^{27}$, 0.7 ± 0.4 μb. The mechanisms are discussed in terms of the single-transfer reactions. There is evidence to suggest that an exchange reaction is not composed of two single-transfer reactions. (auth)

8233 THE ELASTIC SCATTERING OF POSITRONS BY ATOMIC HYDROGEN AND HELIUM. D. C. S. Allison, H. A. J. McIntyre, and B. L. Moiseiwitsch (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 78: 1169-73(Dec. 1, 1961).

Variational methods are employed to calculate scattering lengths for elastic collisions between positrons and hydrogen and helium atoms. Allowance is made for the dipole polarizability of the target atom by using a trial function including a term corresponding to the first-order perturbation of the atom due to the electric field of the positron. The effect of allowing for the dipole polarizability of the atom is to change the sign of the scattering lengths for both hydrogen and helium in agreement with variational calculations for hydrogen. In the case of hydrogen, the total elastic cross section at zero impact energy is increased when allowance is made for polarization, but in the case of helium it is decreased from $0.72\pi a_0^2$ to $0.10\pi a_0^2$. The experimental cross section derived for 18-ev positrons in helium is still smaller, being only $0.023 \pm 0.006\pi a_0^2$. (auth)

8234 THE CONTRIBUTION OF MULTIPLE SCATTERING WITHIN THE NUCLEUS TO THE ELASTIC SCATTERING OF NUCLEONS BY NUCLEI. Alvin M. Saperstein (Univ. of Buffalo). Progr. Theoret. Phys. (Kyoto), 26: 489-98(Oct. 1961). (In English)

The impulse approximation expansion of the nucleon-nucleus scattering operator in terms of nucleon-nucleon scattering operators is rearranged so that it is given by the sum of a term representing repeated scatterings from the same nuclear nucleon and a term representing repeated scatterings from two different nuclear nucleons. When the expansion is limited to double scattering, the result explains some well-known experimental phenomena, namely, the parallelism between the elastic differential scattering cross section and the Born approximation cross section, and the sharp dip in the polarization at the Born approximation diffraction zero. (auth)

8235 ON THE GENERALIZED NILSSON DIAGRAM. Takeo Inoue (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 26: 572-5(Oct. 1961). (In English)

The Nilsson diagram is modified and extended to investigate nuclear shapes. The orbitals of the last nucleons in $Po^{212,214}$ and $Em^{218-222}$ indicate that the equilibrium shape of these nuclei may be $\gamma = 30°$. The high angular momentum states of the upper N shell are essential in lowering large γ configurations. An analogous profile can be shown for the region $126 > N > 82$ and $82 > Z > 60$ and less decisively, in the low mass number region. It is plausible that these nuclei have asymmetric deformation. (L.N.N.)

8236 ALPHA-PARTICLE REDUCED WIDTHS IN HEAVY NUCLEI. Kichinosuke Harada (Japan Atomic Energy Research Inst., Tokyo). Progr. Theoret. Phys. (Kyoto), 26: 667-79(Nov. 1961). (In English)

Alpha reduced widths γ_α^2 for the ground state in Po^{210} and Po^{212} are calculated on the basis of the nuclear shell model. The calculations are made taking the boundary condition in an approximate way into consideration. The effects of the configuration mixing of the parent and daughter nucleus wave functions on γ_α^2 are examined and it is found that they contribute largely to γ_α^2. Features of the distortion of the two-nucleon wave functions arising from the configuration mixing are discussed graphically. It is shown that the wave function of relative motion with the mixing of the level lowered from the upper band by spin-orbit force would correspond to the bound electron-pair in the superconducting metals. Although there are unavoidable uncertainties in the course of the calculations,

it is concluded that the wave functions derived by conventional shell model calculations can explain the major part of the experimental values of γ_{α}^{2}. (auth)

8237 ANALYSIS OF (n,n'γ) CROSS SECTION FOR NUCLEI A ~ 100. A. Sugie, S. Kikuchi, S. Momiyama, and T. Suzuki (Japan Atomic Energy Research Inst., Tokyo). Progr. Theoret. Phys. (Kyoto), 26: 797-9(Nov. 1961). (In English)

The (n,n'γ) cross section near the threshold gives information concerning the optical potential complementary to elastic scattering if the spin-parity of the excited state is known. The reaction proceeds mainly via the compound nucleus. An experiment was performed on Ag and Cd, using the ring geometry. Photons were detected at 70 to 110°. Results were compared with the surface absorption optical potential. (L.N.N.)

8238 SPIN-ORBIT COUPLING IN NUCLEUS. Lianyuan (Liung-yuang) Chu (Academia Sinica, Peking). Wu Li Hsüeh Pao, 14: 469-78(1958).

The distances between the energy levels in the nuclear two-body problem, corresponding to the doublet states (inverse), are calculated using phase shifts. The results are in satisfactory agreement with experiment. Allowance for the spin orbit coupling in the nucleus makes it possible to obtain, with the aid of these data, the relation that should be satisfied by the forces between two nucleons. (Referat. Zhur. Fiz., 8: 19398(1960)).

8239 E3 γ TRANSITION IN NUCLEUS. Yang-kuo Li (Academia Sinica, Peking). Wu Li Hsüeh Pao, 14: 479-87 (1958).

Using the generalized model, the E3 transition between the nuclear levels $7/2^{+} \rightarrow 1/2^{-}$ is considered. (Referat. Zhur. Fiz., 8: 19432(1960)).

8240 CORRECTION TERM TO NUCLEAR QUADRUPOLE MOMENT. Ch'ao-wu Chang (Nankai Univ., Tientsin, China). Wu Li Hsüeh Pao, 15: 630-6(1959).

Using the Brueckner theory, the correction to the value of the nuclear quadrupole moment is estimated, using the shell model. For nuclei containing twice-closed shells plus an odd nucleon (for example, O^{17}), the correction can be calculated by using the shell wave functions and the δ-like two-particle potential. In particular, for O^{17} the correction term is of the order of 10^{-26} cm^2. (Referat. Zhur. Fiz., 9: 22572(1960)).

Particle Accelerators

Refer also to abstracts 7969 and 8057

8241 (MURA-633) SOME REMARKS ON FORCE-FREE COILS. J. Van Bladel (Midwestern Universities Research Assn., Madison, Wis.). Dec. 8, 1961. Contract AT (11-1)-384. 24p.

The possibility of establishing force-free current distributions in infinite cylindrical volumes is examined. It is argued that circular boundaries and fields with circular symmetry yield the only solution to the problem. (auth)

8242 (PPAD-395-D) COMPUTER PROGRAMS FOR MAGNETIC FIELDS AND CHARGED PARTICLE ORBITS IN FIELDS FROM AXIALLY SYMMETRIC COILS. G. Schrank, G. Henry, and J. Swanson (Princeton–Pennsylvania Accelerator, Princeton, N. J.). Feb. 27, 1961. Contract AT(30-1)-2137. 19p.

Computer programs are presented to determine magnetic fields and charged particle orbits in fields of axially symmetric coils. They are applicable to any system of coils with arbitrary cross sectional areas and current densities so long as all coils are coaxial and all current densities have only an azimuthal component. The programs are written in Fortransit language. (M.C.G.)

8243 (TID-13510) Rf POWER SYSTEM FOR A LINEAR ACCELERATOR. Yale Study on High Intensity Proton Accelerators. Internal Report Y-2. George W. Wheeler (Yale Univ., New Haven). July 31, 1961. Contract [AT(30-1)-2726]. 37p.

The availability and cost of an r-f system for a proton linear accelerator having an energy of about 800 Mev and an average beam current between 0.1 and 1.0 ma are discussed. Design philosophy, peak power, duty cycle, pulse length, choice of frequency, power amplifiers, power supplies and modulators, low-level power, phase and operating controls, services, AGS injector application, and methods of obtaining cost estimates are described. (M.C.G.)

8244 (TID-13717) A DEBUNCHING AND MOMENTUM ANALYZING MAGNET SYSTEM. K. G. Steffen (Cambridge Electron Accelerator, Mass.). Apr. 2, 1958. Contract [AT(30-1)-1909]. 12p. (CEA-56(MH))

A magnet system is proposed and analyzed, which serves as debuncher and energy selector for the linac beam. It allows the energy and energy spread of the beam to be varied without affecting spot size and angular spread. (auth)

8245 (TID-13718) SPACE CHARGE EFFECT DUE TO ION TRAPPING. K. W. Robinson (Cambridge Electron Accelerator, Mass.). Sept. 5, 1958. Contract [AT(30-1)-1909]. 9p. (CEA-63(MH))

The change in the betatron frequency due to the focusing effect of positive ion trapping was calculated. The expansion of the beam due to moving the betatron frequency to a resonance, and the limitation to the ultimate intensity due to this effect, were estimated. It was found that the limitation of the intensity is above the proposed operating intensity. (auth)

8246 (TID-13719) CALCULATED RADIATION EFFECTS. Kenneth W. Robinson (Cambridge Electron Accelerator, Mass.). Dec. 1, 1958. Contract [AT(30-1)-1909]. 29p. (CEA-69(MH))

The radiation effects on the synchronous and betatron oscillations in the CEA accelerator were calculated for various operating conditions. It was found that a synchronous phase angle of about 45° at 6 Bev is a reasonable operating condition, and that the radial betatron oscillations do not become excessively large at energies significantly higher than 6 Bev with 60 cycle operation. (auth)

8247 (TID-13720) MAGNETIC MEASUREMENTS ON THE 48 SYNCHROTRON MAGNETS. J. dePagter and H. Winick (Cambridge Electron Accelerator, Mass.). Dec. 15, 1960. Contract [AT(30-1)-1909]. 38p. (CEA-83(MH))

The technique and results of measurements of the fields of the 48 synchrotron magnets at injection time are presented. The major variation among the magnets was found to be due to the differences in the heights of the peaks associated with the packets at the ends and junctions of the magnets. The methods used to reduce the effect of these variations on orbit distortions are discussed. (auth)

8248 COAXIAL HALL CURRENT ACCELERATOR OPERATION AT FORCES AND EFFICIENCIES COMPARABLE TO CONVENTIONAL CROSSED-FIELD ACCELERATORS. John R. Sevier, Robert V. Hess, and Philip Brockman (Langley Research Center, Langley AFB, Va.). ARS (Am. Rocket Soc.) J., 32: 78-80(Jan. 1962).

Analysis of a coaxial Hall current accelerator design based on short or segmented electrodes ($j_x = 0$) indicates that, for the same axial force, the efficiency is only slightly lower than that of a comparable crossed-field accelerator. Since the azimuthal driving current, which does not require electrodes, is larger than the radial current between the electrodes, the direct losses to the electrodes and the temperatures required for thermionic emission are smaller than in the crossed-field accelerator. For the same axial force and same magnetic field, the driving currents of the coaxial and crossed-field accelerators are equal. Thus in spite of the slightly lower efficiencies, which are based on the dissipation due to the total current, the effectiveness of the Hall current accelerator could be higher. The Hall current accelerator, however, requires larger radial electric fields to drive the azimuthal current. Design studies indicate that sufficient cooling of the electrical leads for segmented electrodes could be accomplished, even at high currents, with reasonable cathode diameters. An important advantage of the coaxial accelerator is that it combines the arc jet and accelerator in one package, thereby avoiding the usual intermediate losses between the conventional crossed-field accelerator and its associated arc jet. (N.W.R.)

8249 HIGH-ENERGY, CYCLIC ACCELERATORS WITH A SELF-ADJUSTING MAGNETIC FIELD. E. L. Burshtein, A. A. Vasil'ev, A. L. Mints, V. A. Petukhov, and S. M. Rubchinskii. Doklady Akad. Nauk S.S.S.R., 141: 590-2(Nov. 21, 1961). (In Russian)

To obtain the maximum particle energy in a cyclotron it is necessary to maintain constancy of the number of betatron oscillations per revolution and to hold the amplitude of the forced betatron oscillations to a minimum. Automatic correction of the spread of forced betatron oscillations can be achieved by regulating the local characteristics of the magnetic field after obtaining information on the behavior of the beam. The two main features of the problem involve regulation of the equilibrium orbit and stabilization of the number of oscillations per revolution. It is assumed that the actual motion in an accelerator with strong focusing can be replaced by a "smoothed" motion described by the following differential equations: $x'' + Q^2x = F_t(\theta)$, where x is the axial deviation (radial or vertical), Q is the number of betatron oscillations per revolution (during a change of 2π in θ), and $F_t(\theta)$ is a perturbation which is a periodic function of θ that changes slowly with time. The deviation $x(\theta)$ of the equilibrium orbit is measured at a number of points, and a computer determines the shape and magnitude of the perturbation $x'' + Q^2x$. Then, a correcting perturbation $F_c(\theta)$ is applied by a system of magnetic windings to eliminate the original perturbation. The oscillator frequency or magnetic field is also controlled periodically with a feedback arrangement. The injection of the beam can also be automatically regulated by finding the deviation $x(\theta)$ and calculating the perturbation $x'' + Q^2x$. Approximate parameters were calculated for a triple-cascade arrangement to produce high-energy protons involving an initial linear accelerator, an intermediate cyclic accelerator and a final cyclic accelerator. (TTT)

8250 AN APPROXIMATE DETERMINATION OF CHARACTERISTIC PARAMETER TOLERANCES OF PERIODIC STRUCTURE OF A HIGH-FREQUENCY LINEAR ACCELERATOR AND THEIR COMPENSATION. Bohumil Kvasil (Czech Tech. Univ., Prague). Jaderná energie, 7: 378-83(1961). (In Czech)

A relation for the approximate determination of the influence of tolerances of periodical structure radius of a linear high-frequency electron accelerator on the phase velocity of propagation is derived, and an analysis of compensating its deviations by means of compensating elements is made. Formulas for radius deviation compensation with the aid of dielectric, ferritic, and metal compensating rods are derived. (auth)

8251 RAPID BEAM EJECTOR FOR THE COSMOTRON. David C. Rahm (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 32: 1116-19(Oct. 1961).

The theory and operation of a device that makes the beam in the Cosmotron come onto a target in about 5 μsec instead of the usual 3 msec are described. The magnetic field in a two-turn coil, pulsed with a condenser bank, deflects the internal beam enough to throw the beam onto a target during the rise time of the perturbing field. The system has an inductance of 2 μh and a capacitance of 11 μf, giving a ringing frequency of 34 kc, a peak current of 47 000 amp at 20 kv and a peak field of 1100 gauss. The ejector can also be used to put only a small fraction of the beam onto a target, permitting the rest of the beam to continue on the normal accelerating cycle. (auth)

8252 500-kw PULSE MODULATOR FOR ACCELERATOR APPLICATIONS. George W. Wheeler (Yale Univ., New Haven). Rev. Sci. Instr., 32: 1130-1(Oct. 1961).

A pulse modulator was designed for use with the r-f system of the Yale heavy ion accelerator. This unit combines the desirable features of a hydrogen thyratron with the versatility of a hard tube in a system of relatively low cost. The pulse has a rise time less than 1 μsec and a duration which is variable up to 3.5 msec. A pulse of 8.5 kv at 60 amp can be obtained with a duty cycle of 3.5%. (auth)

8253 A ONE-MEV NUCLEON SLOAN AND LAWRENCE HEAVY-ION LINEAR ACCELERATOR. G. Nassibian, J. R. J. Bennett, D. Broadbent, S. Devons, R. W. R. Hoisington, and V. E. Miller (Univ. of Manchester, Eng.). Rev. Sci. Instr., 32: 1316-26(Dec. 1961).

A description is given of a small heavy-ion linear accelerator based on the use of a twin transmission line. Ions are accepted if their e/m values are $\frac{1}{8}$ or greater (relative to the proton) and are accelerated to a final energy of 1.04 Mev/nucleon. The accelerator has 40 drift tubes fitted with focusing grids, and about 350 kw of pulsed rf are needed for ions of $e/m = \frac{1}{8}$. The radio frequency is 25 Mc, and the accelerator is pulsed at up to 50 pps with a pulse length of 500 μsec. Injection velocity is 0.007 c, corresponding to a dc acceleration from the ion source through 180 kv from an ion of $e/m = \frac{1}{8}$. Ions are produced in a pulsed dc arc of the Penning type operating in a magnetic field of 1000 gauss, and the dc accelerating voltage is supplied by an electrostatic generator. Typical pulsed meter currents so far obtained are, for He^+, input 4 ma, output 150 μa; for N^{2+}, input 3 ma, output 75μa. The accelerator is the first stage of three, which will take the ions to a final energy of 10 Mev/nucleon. (auth)

8254 DEVELOPMENT OF A 100-ma PROTON SOURCE AND LENS SYSTEM FOR THE BEVATRON MARK-II INJECTOR. Robert W. Allison, Jr., Bruce Cork, Robert M. Richter, Joseph F. Smith, Glenn E. White, and Emery Zajec (Univ. of California, Berkeley). Rev. Sci. Instr., 32: 1331-6(Dec. 1961). (UCRL-9743 (Rev.))

A Von Ardenne type ion source and lens system is developed for use as a preinjector to the 18-Mev strong-focusing linear accelerator. Proton beams of 120 ma at an ion production efficiency of 83% are obtained. A magnetic beam-confining system is built, and a beam of 85

ma is transported 82 in. The beam energy is 370 kev, and its emittance is 100 mrad-mm. The beam diameter is 1 cm. This is within the linear accelerator's calculated acceptance of 179 mrad-mm. (auth)

8255 THIN CARBON LAYERS FOR CYCLOTRON TARGETS. R. L. Wolke and V. J. Sodd (Univ. of Pittsburgh). Rev. Sci. Instr., 32: 1415(Dec. 1961).

Layers of C with uniform thicknesses on the order of several $\mu g/cm^2$ are produced by mounting the desired backing on a brass cylinder, placing the cylinder and backing on a lathe, and rotating the cylinder and backing at a uniform rate through the yellow flame of a Bunsen burner. The C deposited is adherent, durable, and over 99% pure. (T.F.H.)

8256 THE REINFORCED RESIN VACUUM ENVELOPE FOR THE 7 GeV PROTON SYNCHROTRON. R. J. B. Hadden and R. Sheldon (National Institute for Research in Nuclear Science, Harwell, Berks, Eng.). p.26.1-26.33 of "Reinforced Plastics Conference, London, 1960." London, 1960." London, British Plastics Federation, [1961].

Research and development in designing a glass reinforced epoxy resin vacuum vessel for the 7 Bev proton synchrotron NIMROD is described. The vessel is in the form of a torus some 50 m in diameter and of cross-section 200 × 25 cm. A thin double wall construction was chosen since this consumes the minimum space. Such a structure must inevitably be a compromise between constructional feasibility and the special requirements for a proton synchrotron, viz. low rate of gas evolution, high radiation stability and of low electrical conductivity. The glass fiber reinforced epoxy resins cured by an acid anhydride are the constructional materials which most satisfy these requirements. The method of manufacture involves the production of pressure laminates in matched tools. The evolution of the present design is described together with factors governing the selection of materials and the cure cycle. Methods of determining the degree of cure in terms of heat distortion point and second order transition temperature are described. Associated problems concerning sealing gaskets and the metallizing of inside surfaces to reduce the area of resin exposed to the vacuum are also discussed. (auth)

8257 IMPROVEMENTS IN OR RELATING TO VOLTAGE GENERATORS. Norman Colston Brookes (to Standard Telephones and Cables Ltd.). British Patent 886,470. Jan. 10, 1962.

A unidirectional voltage generator using a Cockcroft-Walton cascaded rectifier voltage doubler circuit is designed which is self-protective against short-circuits of the load. (D.L.C.)

Plasma Physics and Thermonuclear Processes

8258 (CLM-BIB-1) OSCILLATING ELECTROMAGNETIC FIELD INTERACTION WITH, AND CONTAINMENT OF, PLASMA. A Bibliography. F. B. Knox and C. S. Sabel, comps. (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Oxfordshire, England). Nov. 1961. 28p. (AERE-BIB-121(Suppl.)).

References are presented on oscillating electromagnetic field interaction with, and containment of, plasma. The 509 references covering the period from 1930 through 1961 are arranged by year, and within each year, alphabetically by author. An author index is included. (M.C.G.)

8259 (CLM-R-12) PLASMA CONFINEMENT USING ROTATING MAGNETIC FIELDS. H. Blevin and P. C. Thonemann (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Oxfordshire, England). Oct. 1961. 24p.

An investigation was made of the current distribution set up by a magnetic field rotating about the axis of a cylindrical plasma. If the plasma resistivity was sufficiently small electrons rotated with the magnetic field producing a steady azimuthal current. In conjunction with an externally applied axial magnetic field such a system can be used to confine plasma away from the walls of a discharge tube. Experiments are described in which the radial density distribution was measured and compared with that calculated from theory. (auth)

8260 (MATT-91) THE SCATTERING OF RADIATION FROM A PLASMA. William B. Thompson (Princeton Univ., N. J. Plasma Physics Lab.). Oct. 1961. Contract AT(30-1)-1238. 21p.

An incident beam of radiation is useful for examining radiation scattering by a plasma. The beam thus examines the electron correlation function in the plasma, the scattered radiation being proportional to the square of the fluctuation amplitude. Calculations are presented of the fluctuations in the electron distribution function using the dielectric method used in the derivation of the Fokker-Planck equation. The calculation is simplified by neglecting magnetic effects; but since more detailed information is required, a more careful treatment of the fluctation phenomenon is necessary; in particular, the effect of the ions must be retained. The calculated functions are illustrated by presenting results of the scatter intensity from ionized hydrogen of density 10^{17} at temperature T = 2ev for incident light at 14 400 cm^{-1} at angles of 10, 45, 90, 135, and 180°. (N.W.R.)

8261 (NP-11269) MAGNETOHYDRODYNAMIC STABILITY OF CURVED VISCOUS FLOWS. Technical Report II-29. Ulrich H. Kurzweg (Princeton Univ., N. J.). July 1961. Contract Nonr 1858 (20). 61p.

The stability of viscous flow of an electrically conducting fluid between coaxial cylinders in an external magnetic field was investigated for an arbitrary angular velocity distribution. The cylinder walls were assumed to be nonconducting and the magnetic field had either an axial or radial orientation. Applying the method of small disturbances, the problem was reduced to an eighth order eigenvalue equation, whose solution yielded a secular relation for three dimensionless parameters (eigenvalues) representing the magnitude of the angular velocity, the wave number of the disturbance, and the magnetic field at the onset of instability. The mathematical difficulty encountered in solving the eighth order differential equation directly was avoided by applying a modified Galerkin method to an equivalent set of three simultaneous equations of lower order. Such a procedure yielded very simple polynomial expressions for the curves of neutral stability. The eigenvalue equations were solved and are discussed in detail for the velocity distributions corresponding to Couette and Poiseuille flow in an axial magnetic field and Hartmann flow in a radial field. It was found that in all cases the magnetic field hinders the onset of instability. (auth)

8262 (NYO-9763) THE DEVELOPMENT OF COMPRESSION WAVES IN AN ADIABATIC TWO-FLUID MODEL OF A COLLISION-FREE PLASMA. K. W. Morton (New York Univ., New York. Inst. of Mathematical Sciences). June 30, 1961. Contract AT(30-1)-1480. 41p. (MF-24)

A generalized discontinuous solution was found for the adiabatic two-fluid equations in the steady state: it covers the case of strong shocks and enables a complete account to be made of the steady state solutions of these equations. By considering a piston problem using numerical methods, time dependent solutions of the equations were also found; these rapidly steepened and converged to the discontinuous steady state solutions whenever these existed. (auth)

8263 (TID-14656) OSCILLATIONS AND WAVE PROPAGATION IN PLASMA. Technical Report No. 3. Winston M. Gottschalk (Delaware. Univ., Newark. School of Engineering). Dec. 12, 1961. Contract AT(30-1)-2440. 174p.

Oscillations and wave propagation in plasma are reviewed. Fundamental plasma physics is treated as a background for descriptions of the results of both theory and experiment on oscillations and wave propagation in plasma. Topics covered include particle motion, Debye length, plasma frequency, collisions, Boltzmann equation, further considerations on collisions, moment equations, hydromagnetic or macroscopic equations, organized behavior, basic equations, Landau damping, growing plasma oscillations, and electron beam dynamics. (M.C.G.)

8264 (UCRL-6554) ASYMPTOTIC SCATTERING LOSS FROM A "LONG" MAGNETIC MIRROR SYSTEM. D. J. BenDaniel (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 12, 1961. Contract W-7405-eng-48. 12p.

The asymptotic solutions for the velocity distribution function of trapped ions in the presence of Coulomb scattering in a "long" magnetic mirror system are given. It is shown that, in addition to the asymptotic "normal mode" form in angle, there exists an asymptotic speed form. Expressions may therefore be found for the rate of change of density and mean square speed at long times. (auth)

8265 INTERACTION OF STRONG ELECTRON BEAMS WITH PLASMA. A. K. Berezin, Ya. B. Faĭnberg, G. P. Berezina, L. I. Bolotin, and V. G. Stupak. Atomnaya Energ., 11: 493-7(Dec. 1961). (In Russian)

When a charged-particle beam passes through plasma, charge-density waves are generated in it, resulting in an energy transfer from the beam to the wave and in a reduction of the energy of the beam. The energy losses increase with increasing beam current and with the lowering of the beam energy. This problem was experimentally studied using beam energies of 26 kev and a beam current increased to 8 amp, determining the energy losses occurring during the passage of this beam through a plasma with an electron density in the range of 7 to $9 \cdot 10^{10}$ cm^{-3}. The plasma chambers used consisted of 40-mm diameter and 64- or 32-cm long quartz tubes, kept under a pressure of $3 \cdot 10^{-4}$ to $4 \cdot 10^{-3}$ mm of Hg, using air as medium. The electron beam was at the homogeneous portion of the focusing magnetic field, leaving the largest portion of the plasma chamber outside of the field. A 10-mm diameter La hexaboride disc was used as the cathode of the electron gun. Results indicated that the losses may reach 12% of the electron beam energy, being due primarily to the elastic collision of the electrons with each other, inelastic collision of the electrons with the molecules of the residual gas and generation of longitudinal charge density waves resulting in a coherent interaction between the beam and the plasma. (TTT)

8266 CHARGING LARGE CAPACITOR BANKS IN THERMONUCLEAR RESEARCH. H. K. Jennings (Los Alamos Scientific Lab., N. Mex.). Elec. Eng. (Trans. Am. Inst. Elec. Engrs.), 80: 419-21(June 1961).

Most fusion experiments involve the rapid transfer of energy from large capacitor banks to a system of coils which produce strong magnetic fields to heat and contain deuterium plasma; therefore, it is necessary to have great quantities of stored energy available. The most feasible means of achieving this goal is to charge large capacitor banks to some predetermined voltage and energy level, and then to discharge them rapidly into the gas by triggered switching devices such as ignitrons or spark gaps. A description is given here of various charging systems. (N.W.R.)

8267 THE MAGNETIC CONTAINMENT OF PLASMA. P. A. Davenport (United Kingdom Atomic Energy Authority, Culham Labs., Abingdon, Berks, Eng.). Elec. Rev., 169: 796-8(Nov. 17, 1961).

Complex magnetic field configurations are required for the stable containment of hot plasma, a crucial factor in plasma physics research. The current lines of development in this field are discussed and future possibilities are indicated. (auth)

8268 A MICROWAVE PLASMA DISCHARGE. J. Allison, A. L. Cullen, and A. Závody (Univ. of Sheffield, Eng.). Nature, 193: 156(Jan. 13, 1962).

A striated r-f discharge in argon was produced by high-power, continuous-wave, 3.4-cm wavelength radiation focused into the central region of a discharge vessel. The conditions are ~2 kw source power and 40 to 100 mm Hg argon pressure, and the effects of varying the power and pressure are described. (D.L.C.)

8269 MULTIPLE MAGNETIC FIELD CONFIGURATIONS FOR STABLE PLASMA CONFINEMENT. T. Ohkawa and W. D. Kerst (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuovo cimento (10), 22: 784-99 (Nov. 16, 1961). (In English)

A method of eliminating plasma leakage by connecting cusps with a magnetic field bridge is described. A multipole configuration employing this idea but with no circumferential (B_z) field is discussed. High β plasma is confined with no free plasma surface in the usual cusp model sense. The stability diagram for such configurations is obtained with the pressure of the plasma as a parameter. Generally this condition on the structure is stated as $(B_2/B_1)^2 > r/d$ where r is the radius of the current-carrying rods which produce the multipole field, 2d is the distance between a rod and the conducting wall (bridge width), and B_2 and B_1 are the maximum and minimum fields along the wall surface. Approximations resulting from the magnetohydrodynamic treatment are considered. Practical questions are mentioned and it is shown that in a sample case, confinement time of $\sim 10^{-2}$ sec for a plasma temperature of 10^4 ev is expected. (auth)

8270 INFLUENCE OF ION MOTIONS ON NONLINEAR PLASMA OSCILLATIONS. Russel Vernon (Atomics International, Canoga Park, Calif.). Phys. Fluids, 4: 1524-6(Dec. 1961).

The effect of ion motions on the structure of nonlinear stationary electrostatic oscillations of a cold plasma is investigated. A solution is found by means of an expansion in powers of the electron-to-ion mass ratio m/M. The frequency of oscillation, which is independent of amplitude for vanishing m/M, turns out to be a decreasing function of the amplitude when the ion motions are included. (auth)

8271 STABILITY OF THE SHARP PINCH AND UNPINCH WITH FINITE CONDUCTIVITY. J. D. Jukes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Fluids, 4: 1527-33(Dec. 1961).

The stability of the sharp linear pinch and unpinch is analyzed, using a model in which the magnetic fields are separated by a thin current layer of large but finite electrical conductivity. Elsewhere the contained fluid is assumed to have zero conductivity, a model which may, for example, approximate a plasma pinch heated by the intermixing of skew magnetic fields. The perturbed radial displacement of the layer is assumed to be constant across the layer, and small wavelength perturbations comparable to the layer thickness are not considered. Viscosity is also neglected. The infinitely conducting, "stabilized" pinch and the unpinch are shown to be overstable to perturbations whose helices are approximately orthogonal to the helix of the mean magnetic field across the layer. The overstable growth rate is typically one tenth of the geometric mean of a fundamental oscillatory frequency and the ohmic diffusion rate of the layer. (auth)

8272 ROTATING PLASMA EXPERIMENTS. I. HYDROMAGNETIC PROPERTIES. D. A. Baker, J. E. Hammel, and F. L. Ribe (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 1534-48(Dec. 1961).

Experiments on the Ixion III rotating plasma device, using electrostatic and magnetic probe techniques, are discussed. The data indicate the presence of a two-liter annular volume of rotating plasma whose mean mass density is $\sim 1 \times 10^{-8}$ g/cm^3 and whose rotation decays with the supply voltage in ~ 300 μsec. The plasma energy content of ~ 130 joules appears to be nearly equipartitioned between ordered rotational drift motion and random thermal motion. Under typical operating conditions the data show the existence of drift velocities of $\sim 8 \times 10^6$ cm/sec (~ 65 ev for deuterium) and temperatures of the order of 30 ev. The operation of Ixion as a hydromagnetic capacitor in an oscillatory circuit is described. (auth)

8273 ROTATING PLASMA EXPERIMENTS. II. ENERGY MEASUREMENTS AND THE VELOCITY LIMITING EFFECT. D. A. Baker and J. E. Hammel (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 1549-58 (Dec. 1961).

The total rotational energy and energy loss rate in the Ixion III rotating plasma experiment are measured as functions of time. As the radial electric field is increased, a limiting velocity of rotation of approximately 1.3×10^7 cm/sec is observed. Measurements indicate the presence of a region of fully ionized plasma whose contaminants radiate large amounts of energy in the form of line radiation in the vacuum ultraviolet. Mechanisms proposed to explain the velocity limit are discussed in relation to the experimental results. (auth)

8274 HIGH-β INJECTION INTO A MAGNETIC MIRROR FIELD. F. R. Scott and O. C. Eldridge, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 4: 1558-64(Dec. 1961). (GA-2375)

Axial injection of a high-density helium plasma into a magnetic mirror is experimentally studied. Observations of the plasma-field interaction are made with magnetic probes, electrostatic probes, piezoelectric probes, and an optical monochromator that analyzes emission-line profiles. In the central plane of the mirror a density of $(2 \pm 1) \times 10^{15}$ ions/cm^3 and a maximum ion temperature of 10 ev are indicated. In the upstream region ion temperatures of 35 ± 5 ev are recorded. Diagmagnetic signals show that the high-β plasma "stagnates" near the upstream throat of the mirror. Also, the derived plasma pressure measured on axis decreases exponentially downstream. Piezoelectric-probe measurements show large axial-momentum transfer rates in the downstream region of the mirror, where no diamagnetic signals are observed. The data are compared with a fluid model of a plasma that describes the injection, "stagnation," and effusion along field lines. This experiment indicates that the axial injection of a collision-dominated, high-β plasma into a static mirror field is not efficient for producing and confining a high-temperature plasma. (auth)

8275 MEASUREMENTS OF ELECTRODE DRAG AND CONDUCTANCE IN A SUPERSONIC FREE JET OF PLASMA. Sterge T. Demetriades and Richard W. Ziemer (Northrop Corp., Hawthorne, Calif.). Phys. Fluids, 4: 1568-9(Dec. 1961).

Measurements are made of the electrical and flow characteristics of electrodes that are used in the free-jet method of plasma acceleration. The effective cathode-anode conductance, plasma momentum, and plasma temperature are measured, with the usual magnetic field reduced to zero. It is found that the free jet is surrounded by a sheath, which shields the cold electrodes from direct contact with the hot, fast plasma. Thus currents may be transferred from the electrodes to the plasma without significant electrical, thermal, or viscous losses. (T.F.H.)

8276 NOVEL METHOD OF MEASUREMENT OF PLASMA PROPERTIES BY MOMENTUM-CHANGE TECHNIQUES. Sterge T. Demetriades (Northrop Corp., Hawthorne, Calif.). Phys. Fluids, 4: 1569-70(Dec. 1961).

A method is described whereby the properties of the plasma in a crossed-field plasma accelerator may be calculated, by considering the derivatives of various parameters with respect to others. The mean electron-ion collision time, for instance, is calculated from measured values of d(plasma flow direction)/d(magnetic field strength). The method may also be used to calculate the electron temperatures and concentrations. (T.F.H.)

8277 INJECTED MAGNETIC COMPRESSION EXPERIMENT. E. M. Little, J. Marshall, W. E. Quinn, and T. F. Stratton (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 1570-1(Dec. 1961).

The injection of the plasma, produced by the collision of two D plasmas from coaxial guns, into the Scylla magnetic compression device is studied. The plasma formed by the two guns generally has fast and slow components. The neutron production obtained by trapping each of these components is measured for the cases in which the guiding magnetic field is parallel or antiparallel to the compression field. These measurements are also made using only one of the plasma guns. The use of this plasma injection device is compared with the older Scylla method. (T.F.H.)

8278 CYCLOTRON RADIATION FROM A HOT PLASMA. Ernesto Tortia. Phys. Fluids, 4: 1572-3 (Dec. 1961).

It is shown theoretically that if the magnetic energy in a D plasma exceeds a certain maximum value ϵ_m (about 0.15×10^{-8} erg/electron), losses from Bremsstrahlung and cyclotron radiation exceed the energy produced in the DD fusion reaction, so that no thermonuclear reaction can be ignited or self-sustained. It is noted that reabsorption of the radiation, which is ignored in the calculation, raises ϵ_m, but that plasma thicknesses on the order of several tens of meters are required to bring ϵ_m up to practicable levels. (T.F.H.)

8279 STARK BROADENING OF NEUTRAL HELIUM LINES IN A PLASMA. H. R. Griem (Univ. of Maryland, College Park and Naval Research Lab., Washington, D. C.), M. Baranger, A. C. Kolb, and G. Oertel. Phys. Rev., 125: 177-95(Jan. 1, 1962).

The frequency distributions of spectral lines of nonhydrogenic atoms broadened by local fields of both electrons and ions in a plasma are calculated in the classical path approximation. The electron collisions are treated by an impact theory which takes into account deviations from adiabaticity. For the ion effects, the adiabatic approximation can be used to describe the time-dependent wave functions. The various approximations employed were examined for self-consistency, and an accuracy of about 20% in the resulting line profiles is expected. Good agreement with Wulff's experimental helium line profiles was obtained while there are large deviations from the adiabatic theory, especially for the line shifts. Asymptotic distributions for the line wings are given for astrophysical applications. Here the ion effects can be as important as the electron effects and lead to large asymmetries, but near the line core electrons usually dominate. Numerical results are tabulated for 24 neutral helium lines with principal quantum numbers up to five. (auth)

8280 MEASUREMENT OF STARK PROFILES OF NEUTRAL AND IONIZED HELIUM AND HYDROGEN LINES FROM SHOCK-HEATED PLASMAS IN ELECTROMAGNETIC T TUBES. H. F. Berg, A. W. Ali, R. Lincke, and H. R. Griem (Univ. of Maryland, College Park). Phys. Rev., 125: 199-206(Jan. 1, 1962).

The slab of plasma behind primary or reflected shock fronts served as thermal light source. Electron densities were determined from absolute continuum intensities. Temperatures in helium followed from intensity ratios of ion and neutral lines, or at lower temperatures and in hydrogen from relative line and continuum intensities. Line profiles were measured by scanning with monochromators from shot to shot. Experimental widths and shifts were compared with values calculated from measured electron densities and temperatures. For hydrogen (H_α,H_β,H_γ), neutral helium (5876, 5016, 4713, 4471, 3889, 3188A) and ionized helium (4686, 3203A), the widths agree within 10% with theory. He(II) 4686A exhibits a blue-shift, probably due to the polarization of the plasma near the emitting ions. The measured shifts of the neutral helium lines tend to be smaller than the calculated values, and the agreement with calculated shifts is poorer than in case of the widths. (auth)

8281 RENORMALIZATION OF THE PARTITION FUNCTION IN THE RELATIVISTIC STATISTICAL MECHANICS OF ELECTRON GAS. Keiji Watanabe (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 26: 453-69(Oct. 1961). (In English)

A method of renormalization is calculating the grand partition function of the electron gas is presented. The renormalization is performed by relating the partition function to the finite-time-interval S-matrix. It is shown that the divergencies are eliminated by renormalizing the mass, the charge, and the wave function as in the S-matrix. (auth)

8282 CALIBRATED SCINTILLATOR PROBE FOR DETERMINING ENERGY DISTRIBUTION, DENSITY, AND MEAN ENERGY OF THE ELECTRONIC COMPONENT OF A PYROTRON PLASMA. Robert E. Ellis and Norris W. Carlson (Univ. of California, Livermore). Rev. Sci. Instr., 32: 1367-72(Dec. 1961).

A method of determining some of the characteristics of a deuterium plasma generated and confined in a magnetic-mirror machine is described. The electronic component of the plasma is characterized by a mean energy considerably greater than the ionic component. The mirror configuration readily allows detection of the flux of particles that escape through the mirror loss cone from the plasma confined between the mirrors. Scintillator probes placed near a mirror and outside the confinement region do not interfere with the confined plasma. By the use of thin aluminum absorbers placed in front of the scintillator, a determination is made of the energy distribution of the electron flux as a function of time during the decay of the pulsed mirror field. Such measurements are used to infer plasma conditions by consideration of the processes resulting in the leakage of plasma particles through the mirror. In determining the density of the plasma, the correction to be made to the integral of electron flux over time is based on conclusions as to plasma stability and the known decay rate of the pulsed magnetic field. (auth)

8283 ROTATING PLASMA THERMONUCLEAR DEVICE. (to U. S. Atomic Energy Commission). British Patent 886,165. Jan. 3, 1962.

A plasma containment and heating device is designed which functions in a way similar to an electrical capacitor, storing large quantities of electrical energy in a small volume and having a very short discharge pulse time. The device comprises annular inner and outer electrodes, means for producing a high d-c discharge and a divergent magnetic field between the electrodes, and means for supplying an ionizable gas to the volume between the electrodes. (D.L.C.)

8284 PLASMA DEVICE UTILIZING SELF-TRAPPING OF PLASMA CURRENTS AND MAGNETIC FIELD. (to U. S. Atomic Energy Commission). British Patent 886,360. Jan. 3, 1962.

A fusion reactor is designed with means for transmuting a portion of externally supplied electromagnetic energy into thermal plasma energy. In this reactor, the intermixing heating effect is used to trap the magnetic field energy within the plasma and thereby raise the plasma temperature. (D.L.C.)

8285 METHOD AND MEANS TO GENERATE CONTROLLABLE THERMONUCLEAR REACTIONS IN INDUSTRIAL SCALE AND UTILIZATION OF THE RELEASED ENERGY. Nicholas Constantine Christofilos. British Patent 886,404. Jan. 3, 1962.

An Astron-type thermonuclear reactor is designed in which a layer of relativistic electrons rotating in a magnetic field is used to effect ionization, heating, confinement, and utilization of a plasma. The reactor comprises an elongated cylindrical vessel, solenoid means for producing an axial magnetic field with a central region of uniform intensity and end regions of increased intensity within the vessel, means for injecting high-energy electrons tangentially into the field, and means for introducing thermonuclear fuel into the field. (D.L.C.)

8286 APPARATUS FOR VARYING THE ENERGY OF CHARGED PARTICLES. (to U. S. Atomic Energy Commission). British Patent 886,513. Jan. 10, 1962.

A continuous thermonuclear reactor is designed. The reactor comprises an axial vacuum tank to which charged particles are supplied and in which a traveling wave magnetic field is established. The magnetic field consists of a-c and d-c components superimposed one on each other and forms a continuous series of moving magnetic containment zones. Some of the advantages of continuous thermonuclear reactors over cyclic reactors are given. (D.L.C.)

8287 THERMONUCLEAR REACTOR. James Leslie Tuck (to U. S. Atomic Energy Commission). British Patent 888,471. Jan. 31, 1962.

A thermonuclear reactor of toroidal shape is described in detail. (D.L.C.)

Shielding

Refer also to abstracts 8409, 8410, and 8411

8288 (DC-58-2-195) SHIELDING COMPUTER PROGRAM 12-0—GAMMA RAY PENETRATION—POINT SOURCE. W. E. Edwards and J. J. Loechler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 26, 1958. Contract AT(11-1)-171. 27p.

Shielding Computer Program 12-0 is used to compute the gamma ray flux, energy absorption rate, or dose rate from a point isotropic source of photons of as many as twenty initial energies. Buildup factors through light and heavy materials are combined by empirical expressions obtained by NDA from Monte Carlo calculations. The source-receiver distance and the material path fractions for the straight line connecting the source and receiver are required as input. (auth)

8289 (DC-59-9-124) PULSED NEUTRON MEASUREMENTS ON PLEXIGLAS. K. W. Seemann (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 15, 1959. Contract AT(11-1)-171. 22p.

The diffusion parameters of Plexiglas were measured at 25°C by the pulsed neutron technique with the results: $\bar{v}\Sigma_a = (0.43 \pm 0.01) \times 10^4\ sec^{-1}$, $\bar{v}D = (3.40 \pm 0.10) \times 10^4 cm^2 sec^{-1}$, and $C = 0.00 \pm 0.04\ cm^2$. Quantitative data derived from these parameters show that the macroscopic absorption cross section of Plexiglas for 2200 m/sec neutrons is $\Sigma_a = (0.0195 \pm 0.0005)\,cm^{-1}$; the diffusion constant, $D = (0.136 \pm 0.004)\,cm$, the transport cross section of the hydrogen atom in Plexiglas, σ_{tr} (H) = (38.7 ± 1.2) barns, and the diffusion area, $L^2 = (7.9 \pm 0.3)\,cm^2$. (auth)

8290 (GNEC-187) ENGINEERING PHYSICS METHOD FOR DETERMINING NEUTRON PENETRATION IN IRON–WATER SHIELDS. Supplementary Study Related to BONUS Reactor. (General Nuclear Engineering Corp., Dunedin, Fla.). Aug. 11, 1961. Contract AT(40-1)-2674. 38p.

A three-group diffusion-theory method, developed for calculating the static properties of low-enrichment and high-enrichment light-water cores, was extended to include the calculation of neutron fluxes in the iron–water regions external to the core. The determination of the appropriate fast-neutron diffusion-theory parameters for iron and water regions was found by analytically fitting the experimentally measured thermal-flux-distributions. Also, the transverse buckling measurements were used to derive a simple expression for reflector savings, and account for the neutron leakage perpendicular to the direction in which the calculation was carried out. Comparison of the calculation with experiment is presented for complex iron–water arrangements. (auth)

8291 (RIA-61-1344) CASTABLE MATERIALS FOR NEUTRON SHIELDS. J. W. McGarvey and W. M. Veroeven (Rock Island Arsenal Lab., Ill.). Apr. 4, 1961. 30p.

Elastomeric materials were investigated as hydrogenous shields for neutron radiation. In general, emphasis was confined to those materials with the highest hydrogen densities which can be cast and cured at room temperature. Various liquid natural, butyl, and polybutadiene formulations were evaluated to determine their curing characteristics and suitabilities as neutron shields. The most promising material consisted of an epoxy resin cured, liquid, carboxy-modified polybutadiene filled with polyethylene. (auth)

Theoretical Physics

8292 THE UNCERTAINTY PRINCIPLE AND THE BOHR THEORY. T. Tietz (Univ. of Lódź, Poland). Acta Phys. Acad. Sci. Hung., 13: 363-5(1961). (In English)

The heisenberg uncertainty principle is formulated using the Bohr theory. Examples considered are the one-dimensional harmonic oscillator and the uncertainty principle for hydrogen-like atoms. (L.N.N.)

8293 DIFFERENT MODES OF MOTION IN SPECIAL TRANSLATIONALLY INVARIANT MANY-BODY SYSTEMS. P. Moebius (Technische Hochschule, Aachen). Nuclear Phys., 28: 304-30(1961). (In English)

The motion of a system of A particles with translationally invariant interaction is separated into the center-of-mass motion and the internal motion. For special examples the wave function of the internal motion is split again into a product of two functions, one describing the "global" mode of motion and the other the "specific" mode of motion. The functions of the center-of-mass motion and the global mode of motion depend only on totally symmetric combinations of the particle coordinates. The contribution of the global motion to the energy spectrum is independent of the number of particles. The function describing the specific mode of motion takes into account all conditions for the total wave function that are connected with the Pauli principle, the spin, and the isobaric spin of the system. The corresponding eigenvalue spectrum depends on the number of particles. The structure of the so-called nuclear "collective coordinates" is analyzed. (auth)

8294 MACROSCOPIC CAUSALITY AND LOWER LIMIT FOR THE ENERGY DERIVATIVE OF THE SCATTERING PHASE SHIFT. RELATIVISTIC CASE. Takesi Ogimoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 26: 483-8(Oct. 1961). (In English)

A relation between the macroscopic causality and lower bound of the energy derivative of the scattering phase shift is studied in the case of relativistic quantum field theory. From the requirement of the macroscopic causality the energy derivative of the real part of the phase shift must be non-negative in such an energy region that the imaginary part of phase shift does not vary rapidly with the energy, whereas in another region such an inequality is not generally valid. (auth)

8295 APPROXIMATE CONSTANCY OF ADIABATIC INVARIANTS. L. M. Garrido (Universidad, Saragossa, Spain). Progr. Theoret. Phys. (Kyoto), 26: 577-88(Nov. 1961). (In English)

General criteria to be satisfied by a slowly time-dependent Hamiltonian in order to possess adiabatic invariants of m-th order are given. The degree of approximate constancy of such adiabatic invariants is evaluated. Methods derived are applied to the motion of a charged particle in a magnetic field, i.e., to the harmonic oscillator. (auth)

8296 SUBTRACTION IN THE CHEW-MANDELSTAM EQUATION AND DETERMINATION OF THE LOW-ENERGY SCATTERING AMPLITUDE. Takeshi Kanki (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 26: 611-26(Nov. 1961). (In English)

The subtracted Chew-Mandelstam equation is studied in the approximation that the contributions from the unphysical branch cut are neglected. It is found that when the cut-off function is introduced into the Chew-Mandelstam equation, the subtracted Chew-Mandelstam equation has a new kind of solutions which are not the solutions of

the unsubtracted equation. New solutions are not obtained in the no cut-off case and the subtracted equation becomes equivalent to the unsubtracted one. It is shown in the cut-off case that the new solution has a different feature from those of the solutions of the unsubtracted equation, when the repulsive interaction is introduced using the subtraction, and that the new solution has at least one zero on the real axis. Dynamical and kinematical resonances appearing in the solutions are also discussed. (auth)

8297 CORRELATION BETWEEN MEASUREMENTS IN QUANTUM THEORY. Henry Margenau and Robert Nyden Hill (Yale Univ., New Haven). Progr. Theoret. Phys. (Kyoto), 26: 722-38(Nov. 1961). (In English)

Extension of the postulational basis of quantum theory by introducing correlations between the results of measurements, leads to negative joint probabilities for otherwise meaningful sets of measured values. Since the attempt made is probably the only one compatible with the theory of random variables, and is incompatible with the structure of Hilbert space, it is concluded that correlations are absent. This result, though it is tantamount to a denial of von Neumann's projection postulate and the "reduction of wave packets" on measurement, is shown to be satisfactory from the physical point of view. (auth)

8298 ON A FIXATION OF GAUGE AND TRUE OBSERVABLES OF YANG-MILLS FIELD. Toshiei Kimura (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 26: 790-2(Nov. 1961). (In English)

A derivation is performed starting with a Lagrangian density expression. It is noted that the transverse field is not the true observable in the original sense, since it is not invariant under the isotopic gauge transformation. (L.N.N.)

8299 AN INTRODUCTION TO RELATIVISTIC QUANTUM FIELD THEORY. Silvan S. Schweber. Evanston, Illinois, Row, Peterson and Company, 1961. 914p.

The theory of single particles is examined, with reference to the Lorentz group, symmetry principles, the equations of Klein-Gordon and Dirac, and the zero-mass equations. Second quantization is studied in the non-relativistic case and, in the relativistic case, for the Fock space, the Dirac field, and the electromagnetic field. The theory of interacting fields is treated, on the basis of formal scattering theory, field theoretical models, Feynman diagrams, and quantum electrodynamics. An investigation of renormalization theory is presented. The axiomatic formulation and the Heisenberg approach to quantum field theory are studied. (T.F.H.)

8300 CLASSICAL ELECTRODYNAMICS. John David Jackson. New York, John Wiley & Sons, Inc., 1962. 653p. $13.00.

Maxwell's theory of electromagnetism, along with other fundamental aspects of classical electricity and magnetism, is developed. The special theory of relativity is reviewed, as regards its implications for electrodynamics. Within the frameworks of semiclassical and classical electrodynamics, study is devoted to relativistic particle kinematics and dynamics, charged particle collisions, radiation by moving charges, multipole fields, and radiative reaction. Relativistic effects are stressed. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

8301 (BAW-1231) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM. CRITICAL EXPERIMENTS ON LATTICES MODERATED BY D_2O-H_2O MIXTURES. T. C. Engelder, N. L. Snidow, R. H. Clark, C. E. Barksdale, R. H. Lewis, and M. N. Baldwin (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Dec. 1961. Contract AT(30-1)-2602. 120p.

The results of critical experiments performed under the Spectral Shift Control Reactor Basic Physics Program are summarized. Nine major critical assemblies of rod lattices were studied in moderator mixtures of light and heavy water ranging from zero to 81.2 mole % D_2O. In some assemblies, the moderator was poisoned with boric acid. The non-moderator-to-moderator volume ratio in all lattices was approximately 1.0. The fuel in most lattices was 4%-enriched UO_2 swaged in stainless steel, although two experiments were performed with 93%-enriched UO_2-ThO_2 pellets in aluminum tubes. One assembly was zone-loaded radially and contained both types of fuel. The critical mass, D_2O concentration, boron concentration, buckling, thermal disadvantage factor, and cadmium ratio of U^{235} were measured in each assembly. In most assemblies, the cadmium ratio of U^{238} or Th^{232} was measured, and in five assemblies, the epithermal neutron spectrum was derived from the measurements taken of the resonance activity of detector foils. In special experiments at high D_2O concentrations, the perturbations by moderator gaps and control blades were studied, and the reflector savings versus reflector thickness was measured. The flux distribution in the zone-loaded assembly was also mapped. The measured lattice parameters are summarized. (auth)

8302 (CRE-1048) INVESTIGATION OF CORROSION PROBLEMS IN NRU ORIFICE SECTIONS. M. I. Sturtridge (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Aug. 1961. 96p. (AECL-1370).

A description is given of the corrosion observed on irradiated type 2 and type 3 NRU orifice sections, particularly the corrosion of the outer tube and the control orifice. Tests are outlined and discussed on the original and modified designs of orifice sections to determine the causes of the corrosion and the flow characteristics of single plate multiple hole orifices. An evaluation of modifications to the type 3 orifice section design is given and recommended design modifications are proposed to eliminate the cavitation and impingement corrosion of the control orifice holes. (auth)

8303 (DC-58-4-166) A STUDY OF A REACTOR CONTROL SYSTEM USING AN AIR TURBINE ACTUATOR. W. H. Ward (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). April 23, 1958. Contract AT(11-1)-171. 39p.

Reactor flux control utilizing an air turbine motor as a control rod actuator is examined. The results of a stability analysis are presented together with an examination of the non-linearity introduced by limiting the velocity of the control rod. An analog computer study was also performed to verify the stability analysis and quantitatively determine the effects of control rod limiting velocity. The conclusion is that the system will be stable for any reasonable amount of saturation. Further a limiting velocity of 0.35% reactivity per second or greater will not materially effect the transient response of the system. The main question concerning the air turbine motor that needs further examination is the mechanical reliability. (auth)

8304 (DC-58-5-97) MONTE CARLO RESEARCH SERIES: TWO EXPERIMENTS ON VOID GAP EFFECTS IN A ONE DIMENSIONAL HETEROGENEOUS SYSTEM. J. R. Beeler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 25, 1958. Contract AT(11-1)-171. 27p.

The diffusion length, escape fraction and absorption point distribution were computed for a one-dimensional heterogeneous system of alternating solid and void segments. These results are compared with those computed for the homogeneous counterpart of the heterogeneous system. The solid segments were 1.0 cm long. The void segment length varied from 0.4 to 2.0 cm. The total cross section in a solid segment was 2.0 cm^{-1} and the absorption cross section in the range $0.1-0.4$ cm^{-1}. The difference in diffusion length, between a heterogeneous and homogeneous system, was less than 7% for a point source located at the end of a solid segment and less than 1.3% for a point source located at the center of a solid segment. In a finite geometry the homogeneous model overestimated the leakage fraction and underestimated the absorption point density by as much as 33% in a solid segment. (auth)

8305 (DC-58-8-64) MONTE CARLO RESEARCH SERIES: TWO PROGRAMS FOR COMPUTING SLOWING DOWN PROBABILITY IN AN INFINITE HOMOGENEOUS MEDIUM. J. R. Beeler and J. D. Popp (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 4, 1958. Contract AT(11-1)-171. 20p.

Two programs with 200-level cross section and slowing down tally resolution are described and compared. Sample computations for a Be and hydrogeneous moderator system are given. An additional series of computations for a hydrogeneous moderator system were made to define the effect of the number of histories on the precision of the results. The better program of the two is self-consistent, with respect to changes in the random number generator, to within 0.04–0.2% for $U \leq 14.0$, 0.9% at $U = 18$ and 2.0% at $U = 19.6$. Both programs are coded in CAGE for the IBM 704 computer. (auth)

8306 (DC-59-3-119) INVESTIGATIONS OF SOME PROBLEMS IN FORMULATION OF MONTE CARLO ANALYSES OF GAMMA RAY HEATING IN REACTORS (431421, 51325). S. R. Lenihan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 8, 1958. Contract AT(11-1)-171. 87p.

A compilation of three separate investigation reports in various areas of formulation and programming Monte Carlo analyses of gamma ray heating in reactors is presented. Information is included on gamma ray total attenuation coefficient, the absorption fraction, the pair-production fraction, and a graphical method of jump length sampling. The jump length sampling method is applicable to neutron Monte Carlo programs as well as the gamma ray program, and can also be extended to deep penetration studies. A graphical method of sampling the Klein-Nishina formula for the differential cross sections for Compton scattering of unpolarized gamma rays is presented, and a proposed ray tracing method for a geometry described by a non-intersecting set of closed cylindrical quadric surfaces is described. (auth)

8307 (DC-59-7-3) REACTOR CONTROL COMPONENTS STUDY. PART III. SECOND HARMONIC AMPLIFIER–A LOW LEVEL DC AMPLIFIER. D. P. Shattuck (General Electric Co. General Engineering Laboratory, Schenectady, New York). Feb. 12, 1959. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contract AT(11-1)-171. 38p.

The Second Harmonic Modulator circuit becomes a low level d-c amplifier known as the Second Harmonic Amplifier, when a Thyrite is added to its load circuit. An analysis of this amplifier is presented. Experimental verification of the analysis is available as well as design criteria for the circuit. (auth)

8308 (DC-59-7-4) REACTOR CONTROL COMPONENTS STUDY. PART IV. A MAGNETIC INTEGRATOR FOR PULSED SIGNALS. D. P. Shattuck and D. L. Watrous (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Feb. 26, 1959. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contract AT(11-1)-171. 73p.

A study was made to develop a magnetic integrator that will: be sensitive to a pulsating signal containing no d-c component, perform the time-integration of the intelligence contained in the pulses of this signal, and continuously and nondestructively produce an electrical output corresponding to the value of the integral. A magnetic integrator employing the present transfluxor approach does not appear feasible because a long time constant circuit is required to eliminate migration. As a result the integrator cannot discriminate against noise and the readout excitation destroys flux information. The limitations appear to be a result of the inherent magnetic material characteristics. In addition a signal (Δ pulse) 1-2 decades larger than a minimum detectable signal is required for a linear operation. (auth)

8309 (DC-60-10-76) NUCLEAR REACTOR FISSION RATE DETERMINATION. PART II. H. L. Bermanis (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 14, 1960. Contract AT(11-1)-171. 24p.

When an absorbing disk is introduced into the standard neutron flux of a Σ-pile, this flux will be locally depressed; the inner nuclei of the disk will also be shielded by their outer neighbors from the incident flux. Such a disk may consist of enriched uranium and serve as a calibrating device for the determination of the absolute nuclear power level of a reactor. A program is presented which solves the equations describing the fission rate in such a uranium disk when exposed to the neutron flux in a Σ-pile, with due consideration for the flux depression and self-shielding effects. (auth)

8310 (DP-457) PHYSICS DATA FROM A MOCKUP OF THE HWCTR LATTICE IN THE PDP. William E. Graves (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1960. Contract AT(07-2)-1. 84p.

Experiments were performed in the Process Development Pile (PDP) with a critical mockup of the Heavy Water Components Test Reactor (HWCTR) lattice. Reactivity measurements served to determine control rod worths, the temperature coefficient of the reactor at low temperatures, the dependence of k_{eff} on concentrations of U^{235} and poisons in the "driver" region of the reactor, and the changes in k_{eff} that occur in certain conceivable accidents in the HWCTR. Flux distribution measurements were made to determine over-all flux shapes, local flux variations around individual components, azimuthal flux variations due to asymmetrical combinations of control rods, and vertical flux variations obtainable through the use of control rods of partial length. Sufficiently detailed flux measurements were made to permit the calculation of neutron economy tables and to determine the neutron leakage from the reactor. Suitable adjustments in the input parameters made it possible to fit the experimental results with a two-group calculation. (auth)

8311 (GAMD-1457) DETECTION SYSTEM FOR FAULTY FUEL ELEMENTS IN HTGR. H. W. Georgi (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 15, 1960. Contract AT(04-3)-314. 20p.

Considerations are given for two systems for monitoring the radioactivity of fuel element coolant gases for the detection of leaking fuel elements. One system measures the gas activity directly with a scintillation counter, while the other uses the so-called precipitation method as it is used in all British gas-cooled reactors. Both methods seem feasible for the assumed hold-up times, with the direct detection method delivering higher count rates and faster scanning rates. The feasibility and sensitivity of the precipitation method has been proven on several British reactors where efficiencies to 80% can be achieved. (B.O.G.)

8312 (GAMD-2657) DECONTAMINATION STUDIES AT GENERAL ATOMIC. D. D. Busch and R. M. Watkins (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Dec. 1, 1961. Contract AT(04-3)-314. 7p.

Decontamination studies were directed toward developing methods for cleanup of gas-cooled reactor components, particularly those of the High Temperature Gas-cooled Reactor (HTGR). Procedures are reported for decontamination of gas-bearing He circulators contaminated with Ta^{182}, and removal of non-radioactive oxide films from carbon steel, stainless steel, W, Mg, and Al. A chamber for use in steam and liquid spray decontamination tests was fabricated and installed. The chamber is capable of handling a wide range of contaminated specimen sizes and shapes. (C.H.)

8313 (GNEC-155) TAPE DRIVE AND RADIAL DRIVE CONTROL SYSTEMS. Terminal Report Under Activity No. 70-00-00, Control Development. (General Nuclear Engineering Corp., Dunedin, Fla.). Feb. 27, 1961. Contract AT(11-1)-795. 74p.

A study is made of the feasibility of two types of control rod drive systems: one system utilizes tape-driven vertically moving control rods; the other uses radially moving control blades. The systems are designed for use in water-moderated reactors, and particularly in the BONUS reactor. Preliminary studies are also reported on control of the BONUS reactor by moving the superheater fuel elements radially with respect to the boiler fuel elements. Test results confirm the feasibility of constructing and operating any of these types of drive systems. (T.F.H.)

8314 (HW-68807 and (Add.)) COFIT2–A 709 PROGRAM FOR DETERMINING EXTRAPOLATION LENGTH FROM HORIZONTAL TRAVERSE DATA. D. D. Matsumoto (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1, 1961. Contract AT(45-1)-1350. 28p.

In order to determine the extrapolation length of an exponential pile, the thermal flux across the pile is assumed to fit a cosine function of the form Y = A cos B (X – C), where Y = corrected thermal flux and X = measurement position in cm from pile centerline. It is desired to determine the parameters A, B, and C that best fit the data, as well as the standard deviations S_A, S_B, and S_C due to uncertainties in the measured data. A is the corrected value of thermal flux at the effective center of the pile.

C is the displacement of the effective pile center from the physical pile center. The effective pile width, H, may be determined from B by H = π/B. COFIT2 is a 709 program which performs this analysis of experimental data. It is used in conjunction with VTOCL, a code which determines material buckling from vertical traverse data taken in an exponential pile. The uses, method of analysis, and input requirements of COFIT2 are described in detail. The program is a revision of the HW-61204 program, now obsolete. (N.W.R.)

8315 (HW-71811) PUVE—A COMPUTER CODE FOR CALCULATING PLUTONIUM VALUE. E. A. Eschbach, M. F. Kanninen, and S. Goldsmith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1, 1961. Contract AT(45-1)-1350. 68p.

Factors are discussed which must be considered if Pu is utilized as a replacement for, or supplement to, U^{235} enrichment in fuel cycles. Plutonium value is defined, and factors which influence this value, and the role of Pu value in evaluating various fuel cycles are considered. The Pu value equations for nonbreeding reactors are formulated. A computer code, PUVE, was developed to take into account the variations of Pu value with Pu isotopic content. PUVE solutions for Pu value equations are described. (C.H.)

8316 (TID-8200(5th Rev.)) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF DECEMBER 31, 1961. (Division of Reactor Development, AEC). 26p.

Information is presented about facilities built, being built, or planned in the United States as of December 31, 1961, which are capable of sustaining a nuclear chain reaction. The information is presented in the five following categories: civilian reactors (domestic), military reactors, production reactors, reactors for export, and critical assembly facilities. (M.C.G.)

8317 (TRG-Report-127) A COMPARISON WITH EXPERIMENT OF TRANSIENT RESULTS FROM THE SPATIAL KINETICS PROGRAM STAB. W. J. Pickering (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). Sept. 28, 1961. 14p.

A controlled start-up on a Calder reactor has been simulated using the spatial kinetics program STAB. A comparison of the experimental and STAB results was made. There is very good agreement in the spatial effects arising in can temperature distributions throughout the run; any differences can be explained by the presence of experimental fuel elements near the center of the core. The STAB program appears to be performing reactor transient calculations correctly and, providing adequate data are available, can be used for predicting behavior of similar thermal reactors. (auth)

8318 (WAPD-TM-303) BOUND 1, 2, 3—IBM 704 PROGRAMS FOR THE ANALYTIC SOLUTION OF THE ONE ENERGY P_3 APPROXIMATION IN CYLINDRICAL GEOMETRY. W. W. Clendenin and H. G. Gelbard (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1961. Contract AT(11-1)-Gen-14. 31p.

The BOUND programs obtain analytic solutions to the one energy P_3 approximation for one and two region problems in cylindrical geometry. The principal restriction is an isotropic, regionwise constant source. The programs provide for the treatment of a void in the system. Marshak boundary conditions, and cell boundary conditions where appropriate, are internal as options. It is possible to utilize boundary conditions with arbitrary coefficients specified by the user. (auth)

8319 (XDC-55-5-123) CORRELATION OF SHAPED WIRE TYPE FUEL ELEMENT DATA IN FORM APPLICABLE FOR PREDICTION OF PRESSURE LOSS WITH HEAT ADDITION. R. N. Noyes (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 12, 1955. Contract AT(11-1)-171. 12p.

The test data reported in XDC 55-2-43 was recorrelated into a form which would be applicable for the prediction of pressure loss with heat addition. With the exception of 17 out of some 150 data points, friction factor variation was restricted by a range of 10% around a mean correlation line. An example is worked out to illustrate the use of this correlation in predicting pressure drop with friction and heat addition. (auth)

8320 (XDC-55-5-125) POSSIBLE USE OF ELECTROMECHANICAL RELEASE MECHANISMS FOR A COMPRESSED GAS–BORON POWDER NUCLEAR FUSE. R. J. Spera (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 26, 1955. Contract AT(11-1)-171. 10p.

Electromechanical devices were found to be impractical as release mechanisms for nuclear fuses. The quantity of energy required to release the compressed gas of the fuse is much greater than the amount that can be stored within the fuse volume. (auth)

8321 (XDC-59-8-206) SUMMARY OF MTR TESTS IN HT-1 FACILITY. A. E. Focke (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 8, 1959. Contract AT(11-1)-171. 58p.

A summary of all GE-ANP metallic fuel element tests in the HT-1 facility of the Materials Testing Reactor is given. (auth)

8322 (XDC-59-11-72) SUPPLEMENT 1 TO APEX 515, CROSS SECTIONS FOR REACTOR ANALYSIS. M. J. Stanley (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 26, 1959. Contract AT(11-1)-171. 33p.

Since the publication of APEX 515, "Cross Sections for Reactor Analysis," new records were added to the IBM 704 nuclear data tape. The purpose of this supplement is to acquaint the users of the nuclear data tape with the latest additions and to document the cross section data. The new or revised records pertain to the atomic mass number 234, 235, 236, and 238 isotopes of uranium, rhenium, iron, nickel, chromium, and niobium. (auth)

8323 SYMPOSIUM ON BURST-SLUG DETECTION IN NUCLEAR POWER STATIONS. PART I. EXPERIENCE WITH BRITISH EQUIPMENT. PRINCIPLES OF BURST-CARTRIDGE DETECTION SYSTEMS. F. T. Law (Central Electricity Generating Board, [London]). Trans. Soc. Instr. Technol., 13: 140-1(Sept. 1961).

The principles and some possible methods for detecting fission products leaking from burst slugs in a large gas-cooled reactor are discussed. The reasons for this detection system and the reason for the choice of a particular method are also discussed. (N.W.R.)

8324 SYMPOSIUM ON BURST-SLUG DETECTION IN NUCLEAR POWER STATIONS. PART II. EXPERIENCE IN FRENCH REACTORS. THE FISSION-PRODUCTS DETECTOR. André Roguin (Commissariat à l'Énergie Atomique, [Paris]). Trans. Soc. Instr. Technol., 13: 160-3(Sept. 1961).

A fission-products detector developed by the French for the detection of burst slugs in a gas-cooled reactor is described along with the principles and operation of the rotating electrode detector. The detector works on the principle of electrostatic precipitation and is used where the

coolant gas is carbon dioxide. A diagram is given of the circuit system used in connecting the detector to the reactor. (N.W.R.)

8325 REGELUNG UND INSTRUMENTIERUNG VON KERNREAKTOREN. I BAND. GRUNDBEGRIFFE UND GRUNDLAGEN. (Control and Instrumentation of Nuclear Reactors. Volume I. Fundamental Principles and Bases). Ludwig Merz. Munich, R. Oldenbourg, 1961. 454p. DM 78.

Measuring and control techniques for nuclear reactors are discussed. The fundamental physical principles of reactors are outlined. Reactor technology and reactor dynamics are reviewed. A survey is presented of the most important problems of reactor measurement and control techniques. The state of control techniques for nuclear power plants is described. (M.C.G.)

8326 COMPOSITE NUCLEAR FUEL ELEMENT AND NUCLEAR REACTOR INCORPORATING THE SAME. (to U. S. Atomic Energy Commission). British Patent 885,891. Jan. 3, 1962.

A sandwich-type fuel element is designed comprising a flat plate having a plurality of compartments in which fissile or fertile material is located and clad to enclose the material. The fissile or fertile material is preferably in ceramic form and not bonded to the flat plate or cladding plates. Some of the advantages of the sandwich fuel element over rod type fuel elements are greater heat transfer surface, easier fabrication, and decreased release of fission products into the coolant in case of cladding rupture. The design of a reactor of the pressurized light water seed and blanket type for utilizing these fuel elements is given. (D.L.C.)

8327 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Norman Bradley (to United Kingdom Atomic Energy Authority). British Patent 885,937. Jan. 3, 1962.

A boiling reactor is designed in which a first mixture of feed water and steam is used to raise saturated steam, which in turn is used to form a second mixture of feed water and steam for raising further saturated steam and finally superheated steam. The proportions of steam and water in these mixtures before passage through the reactor core are 10 to 20 wt % and 90 to 80 wt %, respectively. The advantages of such a reactor are that such mixtures of steam and water are superior as a heat transfer medium to steam or water used alone and that fuel elements in the non-superheating passes are operated at relatively low temperatures and hence can be canned in zirconium. (D.L.C.)

8328 IMPROVEMENTS IN AND RELATING TO CHARGE PANS FOR NUCLEAR REACTORS. Peter John Rawson, Herbert Henry Heath, Terence Ingham, and Douglas Frank Seymour (to English Electric Co., Ltd.). British Patent 886,018. Jan. 3, 1962.

A charge pan for graphite-moderated reactors is designed for reduction in the amount of piping required for coolant sampling systems. The pan is made in two sections, one being a removable cover, and a gas sampling pipe system is fitted between the two sections and emerges laterally from between them. (D.L.C.)

8329 IMPROVEMENTS RELATING TO SHOCK ABSORBING APPARATUS. John George Morland (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 886,317. Jan. 3, 1962.

A shock absorber is designed for absorbing an impact shock on the end of a reactor control rod when it is dropped. The absorber comprises a buffer member projecting from the bottom of the control rod, retaining members connecting the buffer member with the control rod and which is broken on impact, and deformable members (collapsible discs) between the buffer member and control rod which absorb the impact energy. (D.L.C.)

8330 NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). British Patent 886,323. Jan. 3, 1962.

A boiling water reactor for producing superheated steam is designed which avoids the extensive piping required in previous boiling reactors. The reactor core is divided into two distinct regions, one for boiling and the other for superheating. (D.L.C.)

8331 NUCLEAR FUEL MATERIAL. (to U. S. Atomic Energy Commission). British Patent 886,446. Jan. 10, 1962.

A method is given for preparing carbides of uranium, thorium, and/or plutonium with a reduced surface chemical activity and readily comminuted to the proper size for reactor fuel use. The method comprises forming the silicide of the metal, comminuting the silicide to the desired degree, and carburizing the silicide to produce an intimate mixture of the carbide of the metal and carbon silicide. (D.L.C.)

8332 POWDER COMPACT FOR NUCLEAR REACTOR FUEL ELEMENTS. (to U. S. Atomic Energy Commission). British Patent 886,915. Jan. 10, 1962.

A novel fissionable-fuel bearing powder composition may be prepared which is non-reactive with aluminum during fabrication into compact fuel elements and subsequent use in reactors. The composition comprises a mixture of aluminum and uranium carbide, the carbide portion containing at least 80 wt. % UC_2 and being preferably prepared by fusing a uranium–carbon mixture. Reactivity data are presented for mixtures containing various proportions of UC_2 and UC and Al fired at 620°C for times up to 96 hr. A fabrication method is outlined for producing sandwich-type aluminum-clad fuel plates from such mixtures for use in MTR-type reactors. (D.L.C.)

8333 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Everett Long and Dennis Ross Poulter (to United Kingdom Atomic Energy Authority). British Patent 887,142. Jan. 17, 1962.

A gas-cooled reactor is designed with a multiple pump-driven coolant circuit arranged so that, if one individual pump should fail, the reactor need not be shut down immediately and the pump can be replaced without interrupting the coolant flow. The circuit comprises a group of channels connected in series by connections between the inlet and outlet ducts, a plurality of coolant-circulating pumps, and a heat exchanger in each of the connections. The inlet ducts are joined by one ring main and the outlet ducts by another ring main, both ring mains having isolating valves or being of high impedance to gas flow. In operation, if one pump fails, the coolant flow continues at a level slightly below normal and the pump can be replaced when its associated isolating valves are closed, the coolant by-passing the faulty pump by means of the ring mains. (D.L.C.)

8334 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Clive Frederick George Dupen (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 887,145. Jan. 17, 1962.

A fuel assembly is designed for gas-cooled, graphite-moderated reactors. The assembly comprises an array of clad UO_2 plates spaced apart and supported at their side edges by slanting grooves in vertical support members;

the plates are provided with tabs at each corner for holding the plates in position in the grooves. A series of such assemblies are stacked in a zig-zag fuel passage in such a way that the coolant is caused to follow a zig-zag path in passing through the assemblies successively. (D.L.C.)

8335 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. William Kenneth Bolton (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 887,146. Jan. 17, 1962.

A robust graphite block design is described which is particularly applicable to reactors with zig-zag fuel passages such as that described in British Patent 887,145. The blocks are vertically aligned to form a plurality of stacks with fuel passages formed out of the vertical abutting faces of the blocks in a pair of adjacent stacks. (D.L.C.)

8336 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Hugo Heinrich Ludolf Ritz and Edward Rae Elliott (to C. A. Parsons & Co., Ltd.). British Patent 887,178. Jan. 17, 1962.

A fuel element is designed which is suitable for stacking one upon another in a reactor. The fuel element comprises a container housing the fuel and end closure members shaped to have at one end a conical recess and at the other end a conical projection. Both end closure members have fins running in the direction of the longitudinal length of the element to contribute to further cooling of the parts bearing the weight of the stacked fuel elements. (D.L.C.)

8337 METHOD AND APPARATUS FOR THE INVESTIGATION OF NEUTRON PROPAGATING MEDIA. (to Commissariat a l'Energie Atomique). British Patent 887,197. Jan. 17, 1962.

A method and an apparatus are described for investigating the neutron-propagating characteristics of a medium, e.g., the Laplacian operator and diffusion length. The method comprises irradiating a sample of the medium from all around the sample, controlling the irradiation rate, and detecting the resulting neutron flux at points within the sample. Various ways of carrying out the irradiation are described. (D.L.C.)

8338 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Thomas Deighton (to Babcock & Wilcox, Ltd.). British Patent 887,252. Jan. 17, 1962.

A pressurized water reactor is designed for emergency removal of heat due to fission product decay during shutdown. The reactor is provided with an emergency heat exchanger in a normally ineffective natural circulation circuit. This circuit is activated automatically by a predetermined rise in the coolant level due to thermal expansion. (D.L.C.)

8339 A SELF COMPENSATING SIDE LOADING RESTRAINT UNIT FOR USE IN NUCLEAR REACTORS. Eric Victor Lockney (to Head Wrightson & Co., Ltd.). British Patent 888,307. Jan. 31, 1962.

A side-loading assembly for applying centripetal force as restraint means on a reactor core is designed which compensates automatically for core expansion and contraction. The assembly comprises a series of lever mechanisms attached at their inner ends to points on the core or to brackets fixed thereto and at their outer ends to a fixed base. A vertical load, e.g., a weight or a compressed spring, is applied to furnish a centripetal stabilizing force on the core. (D.L.C.)

8340 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR CONTROL ARRANGEMENTS. Geoffrey Frank Bennett (to General Electric Co., Ltd.). British Patent 888,394. Jan. 31, 1962.

A reactor control arrangement in which de-energization of electromagnets is used to release shutdown rods into the core is designed which prevents the possibility of a spurious tripping signal shutting down the reactor. In this arrangement, each electromagnet has three, not just one, energizing windings arranged to release the rod in the event of de-energization of two or three windings. (D.L.C.)

8341 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Sydney Fawcett and Frank Geoffrey Greenhalgh (to United Kingdom Atomic Energy Authority). British Patent 888,465. Jan. 31, 1962.

A re-entrant cooling system is designed for reactors. The system comprises two tubes, an outer tube with a closed end and an inner tube with an open end in the vicinity of the closed end of the outer tube; the part of the inner tube equipped with nuclear fuel is made out of zirconium and the part free from fuel is made out of mild steel. (D.L.C.)

8342 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR MODERATOR STRUCTURES. Stanley Hackney (to United Kingdom Atomic Energy Authority). British Patent 888,602. Jan. 31, 1962.

A graphite moderator structure is designed which minimizes distortion due to Wigner growth. The structure comprises a mass of graphite blocks arranged into interlocked layers; the blocks in each layer are spaced from one another at their side faces and are of alternately larger and smaller cross section in any one row, and the larger blocks in one row locate at their edges the larger blocks in adjacent rows. The direction of minimum Wigner growth in the blocks is arranged so that along any line drawn through the corners of a diagonal series of larger blocks in a layer, the direction alternates from one block to the next. (D.L.C.)

Power Reactors

8343 (ANL-6084) INITIAL TESTING AND OPERATION OF THE ARGONNE LOW POWER REACTOR (ALPR). Eberhard E. Hamer, ed. (Argonne National Lab., Ill.). Dec. 1959. Contract W-31-109-eng-38. 261p.

The major events of a program designed to test and operate the completed reactor power plant and associated equipment are described. The design and construction phases of the project, component installation, preliminary systems testing, zero-power experiments, areas affected by the design parameters, reactor operation, plant safety, and reactor operator training are covered. (W.D.M.)

8344 (APAE-75) PM-2A CORE I ZERO POWER EXPERIMENT. T. M. Raby, S. H. Weiss, E. W. Schrader, L. D. Walthousen, R. A. Robinson, and W. J. McCool (Alco Products, Inc., Schenectady, N. Y.). Oct. 21, 1960. Contract DA-30-347-ENG-284. 54p.

The PM-2A Core I zero power experiment was performed to establish fuel element and absorber uniformities, control rod critical bank positions, and on-site initial core loading procedures. Results indicated satisfactory distribution of fuel and poison in fuel elements. Anticipated B^{10} fabrication loss was 35%, while the estimated stationary fuel element B^{10} loading of 0.425 gm per element represented an average B^{10} loss of approximately 42% from the specified 0.728 gm per element. This estimate was based on reactivity differences obtained by intercomparison with an SM-1 Core I standard element. Assuming the same estimated loss for control rod fuel elements, average B^{10} loading would be approximately 0.335 gm, against the loaded

0.574 gm. Europium absorber sections showed high uniformity when checked against each other. Criticality was initially attained with 16 fuel elements (11 stationary and 5 control rod), containing 8101.74 gm U^{235}, at a five rod critical bank position of 18.921 inches. Minimum critical mass measurement, utilizing a 4 by 4 fuel element array with one corner element missing and 3 control rod assemblies, was 7789.68 gm with a three rod critical bank position of 21.513 inches. The full core (37 fuel elements) had a total mass of 19,490.88 gm U^{235}, and the five rod critical bank position was 6.384 inches. Stuck rod measurements demonstrated that reactor criticality may be attained by withdrawing any single control rod (17.565 in. for the center rod, 19.559 in. for an outside rod). The initial on-site core loading procedures developed will ensure safety and efficiency without requiring an inverse multiplication approach to criticality. (auth)

8345 (APAE-Memo-300) SUPPORTING ANALYSIS AND DERIVATION OF DIMENSIONAL TOLERANCE SPECIFICATIONS FOR CORE II OF SM-1A & PM-2A. J. O. Brondel (Alco Products, Inc., Schenectady, N. Y.). Nov. 3, 1961. Contract AT(30-1)-2639. 45p.

A method is presented for translating inspection measurements of fuel plate spacing to obtain minimum coolant channel clearances under reactor operating conditions. Considerations of fuel plate ripple growth and the inspection procedure used are included. The method is applied to establish dimensional tolerance specifications used for the procurement of SM-1A and PM-2A Core II. (auth)

8346 (APEX-902) P-1 NUCLEAR TURBOJET. COMPREHENSIVE TECHNICAL REPORT, GENERAL ELECTRIC DIRECT-AIR-CYCLE AIRCRAFT NUCLEAR PROPULSION PROGRAM. L. A. Bergsten—D. H. Culver, ed. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Nov. 30, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 72p.

The design of the reactor for a direct-air-cycle nuclear power plant is described. Presented are the bases for selection of the moderator, fuel element material and shape, basic reactor configuration, design point selection, and turbomachinery selection. Details are presented of the methods used to flatten power radially and longitudinally, verify nuclear design (critical mockup and shield mockup), and fabricate fuel elements. The control system and its components are described, including the control console and instrumentation. The design of the shield and moderator cooling systems are reported. The modifications of conventional turbomachinery are included—in-pile combustors, ducting and duct arrangement, valving, and the turbomachinery controls. The Propulsion Unit Test, for chemically simulating reactor operation, is also described. (auth)

8347 (BAW-1145) NUCLEAR MERCHANT SHIP REACTOR PROJECT QUARTERLY TECHNICAL REPORT, JANUARY–MARCH 1959. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Contract AT(30-3)-274. 97p.

Stress calculations proved the adequacy of the primary inlet piping configuration. Vibration snubbers are provided for at about 20 points on the primary piping, pumps, steam drums, and pressurizer. Final reactor design curves were completed. Various experiments performed in the critical experiment program are reported. A prototype manufacturing process for the fuel pellets was developed. Vertical and inclined testing of the prototype control rod drive-line was completed. In the reactor primary system, flushing connections were added to the upper end-turn of the primary pump cooling coils. Primary shielding was modified to reduce dose rates. Equilibrium fission product activity in the buffer seal system was investigated. (B.O.G.)

8348 (DC-56-12-29) AIR COOLING OF A STAINLESS STEEL TUBE. S. E. Eckard (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). November 28, 1956. Contract AT(11-1)-171. 14p.

Curves are presented showing the air mass velocity necessary to cool a stainless steel tube. The tube is surrounded by a high temperature silicon carbide surface. (auth)

8349 (DC-57-6-126) HTRE NO. 2–PROJECT 101 OPERATION HANDBOOK FOR REACTOR A4 AND A5 CODE 22. M. H. Ferguson, ed. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 1, 1957. Contract AT(11-1)-171. 209p.

A description and operating procedures for HTRE No. 2 are presented. Diagrams, drawings, and photographs are included. (M.C.G.)

8350 (DC-58-3-37) INSPECTION DATA ON MODERATOR TUBES FOR INSERT 1-D. J. O. Woodbridge (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 4, 1958. Contract AT(11-1)-171. 17p.

The history and inspection information are presented on the seven clad hydrided-zirconium moderator tubes used in the 1-D assembly for HTRE-2 one-tube burnout tests. (auth)

8351 (DC-58-3-128) NUCLEAR DATA COMPILATION, D-102A REACTOR. H. Dries (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 5, 1958. Contract AT(11-1)-171. 55p.

A compilation of all the nuclear data pertinent to the analysis of the D-102A reactor is presented. A general description of the reactor, the equivalent nuclear configuration, calculated data on cell correction, two group constants, and flux distributions are included. (auth)

8352 (DC-58-8-116) ASSEMBLY, INSTALLATION, OPERATION AND CONTROL INSTRUCTIONS FOR D102A NUCLEAR SENSORS (13, 23-7400). R. R. Swope, comp. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 1, 1958. Contract AF33(038)-21102 and AT(11-1)-171. 127p.

A handbook is presented in which the assembly, installation, operation, and control of the nuclear sensors for the D102A power plant are described. (auth)

8353 (DC-58-8-191) CALCULATED SECONDARY HEAT GENERATION IN THE D102A REACTOR. J. G. Keppler and S. R. Lenihan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 21, 1958. Contract AT(11-1)-171. 36p.

The calculated results of secondary heating in the D102A reactor assembly are presented. The principal components include the reactor core, front and radial reflectors, tube sheets, Inconel pressure vessel, and shield. Heating effects considered were neutron moderation, core produced gammas, and extra-core neutron capture gammas. Data on distribution of heating among the various reactor components are also included. (auth)

8354 (DC-58-8-192) SINGLE ENGINE SHIELD MECHANICAL DESIGN STUDY. F. J. Frank (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 22, 1958. Contract AT(11-1)-171. 47p.

The mechanical design and aero-thermodynamic evaluation of an air-cooled front shield which is incorporated in the single-engine, shaft-through-core reactor, and X-211 engine are described. The front and rear plugs are of the annular type. (auth)

8355 (DC-58-11-144) SOME ASPECTS OF CONTROL MATERIAL SELECTION FOR RELATIVELY HIGH TEMPERATURE REACTORS. C. B. Magee (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 14, 1958. Contract AT(11-1)-171. 54p.

Information on the absorption of neutrons by nuclides and the dependence of absorption cross sections on neutron energy is presented. A comparison of the absorptive properties of several specific materials based on their relaxation lengths is included. (J.R.D.)

8356 (DC-59-5-221) IET PHASE I TEST REQUEST. Ben Blumberg, Jr. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 21, 1959. Contract AT(11-1)-171. 41p.

A test request for the Phase I testing of the D102A at the IET facility is presented. Included are test requests, purpose of tests, data required, and special operating instructions and limitations. (auth)

8357 (DC-60-8-67) HTRE NO. 3 THERMODYNAMIC PERFORMANCE. W. C. Powell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 12, 1960. Contract AT(11-1)-171. 70p.

Thermodynamic data from all HTRE No. 3 testing to date were condensed, compared with predictions, and interpreted wherever possible. (auth)

8358 (DLCS-3070202) PRIMARY PLANT SELF-ACTUATED RELIEF VALVE OPERATION. CORE I, SEED 3. Test Evaluation. Section 2. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 12, 1962. Contract [AT(11-1)-292]. 13p.

A test was conducted on August 12 to 13, 1961, on the operation of the four reactor coolant loop relief valves and the four purification system relief valves. The results indicated proper operation. (D.L.C.)

8359 (DLCS-3570302) REACTOR PLANT CONTAINER INTEGRITY TEST. Test Evaluation. Section 3. (Duquesne Light Co., Shippingport, Penna.). First Issue, Jan. 4, 1962. Contract [AT(11-1)-292]. 21p.

A test was carried out to inspect the interconnections and all pipe penetrations of the reactor plant container for signs of damage or rupture. A positive bolt tightness for the container hatches, reactor dome, and electrical stop joints was established using a bolt torque sequence of tightening diametrically opposite bolts simultaneously. Figures and tables are included. (M.C.G.)

8360 (GA-2603) MARITIME GAS-COOLED REACTOR PROGRAM. A REVIEW OF THE MARITIME GAS-COOLED REACTOR PROGRAM. Kenneth A. Trickett (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Dec. 22, 1961. Contract AT(04-3)-187. 27p.

Presented at the Eleventh Professional Divisions Conference of the San Francisco Section of the American Society of Mechanical Engineers, November 16, 1961.

The MGCR program and its objectives are discussed. The basic MGCR plant is described. The design of the Experimental Beryllium Oxide Reactor is also described. (M.C.G.)

8361 (GEAP-3538) NUCLEAR SUPERHEAT PROJECT FOURTH QUARTERLY PROGRESS REPORT, APRIL–JUNE 1960. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189.

The progress and results on the conceptual design, economic evaluations and research and development work on the Nuclear Superheat Project are reported. Conceptual design program evaluation, fuel technology, materials development, experimental physics, coolant chemistry, heat transfer, mechanical development, SADE, and mixed spectrum superheat study are discussed. (M.C.G.)

8362 (GNEC-154) BONUS REACTOR SUPERHEATER FUEL EMERGENCY COOLING. Terminal Report Under BONUS Activity No. 66-7, Superheater Fuel Emergency Cooling Tests. (General Nuclear Engineering Corp., Dunedin, Fla.). Dec. 21, 1960. Contract AT(40-1)-2674. 49p.

An emergency cooling system was developed for cooling the superheater fuel assemblies in the BONUS reactor before melting of the fuel occurs due to a complete loss of moderator water and steam coolant. The system consists essentially of a tube sheet pan and eight four-way distribution tubes for each BONUS superheater fuel assembly. The tube sheet is located near the top of the fuel assembly, and the four-way distributors are mounted in the tube sheet at the midpoint of each cluster of four superheater-fuel pressure tubes. The four-way distributors are sections of tube, approximately 0.2 inch in diameter and 0.6 inches long, each of which have a closed lower end and four side orifices. The four-way distributors are designed such that 1.25 gallons of emergency water per minute delivered to the distribution pan of each superheater assembly will cause the water level in the pan to rise ½ inch. This head of water is sufficient to allow an even distribution of approximately 0.04 gpm of water to each of the 32 pressure tubes of the superheater fuel assembly. Water droplets therefore come in contact with almost all elevations of the pressure tube simultaneously. Experimental results indicated that the temperature of heated tubes does not rise an appreciable amount once water flow at the distributor starts and that the temperature of a 24-in.-long simulated fuel tube can be reduced from 1400 to 300°F in about three minutes. It was estimated that in the event of a loss-of-coolant-and-moderator accident the temperature-rise of the BONUS superheater fuel assembly materials will be terminated within a few seconds after water reaches the distribution pans. After six minutes of operation of this emergency cooling system, the temperature of the tubing and the fuel will be reduced approximately 1000°F or more depending on the initial temperature existing prior to the emergency water cooling. Delays of the order of 2 to 3 minutes before spraying of the superheater fuel assemblies may result in the melting of some fuel clad at the maximum calculated hot spots. However, the UO_2 fuel at these spots will not reach melting for approximately 6 minutes. Melting of the UO_2 fuel in the superheater fuel assemblies can be prevented by supplying water to the system within six minutes after a loss-of-moderator-and-coolant has occurred; some melting of the clad at local hot spots would be expected. In the BONUS plant design, it is expected that emergency cooling can be provided much sooner than six minutes and that local hot-spot melting of the UO_2 may be prevented. (auth)

8363 (GNEC-177) BONUS SUPERHEATER FUEL ASSEMBLY UNFLOODING TEST. Terminal Report under Activity No. 60-00-00, Insulation and Seal Connector Development. (General Nuclear Engineering Corp., Dunedin, Fla.). June 15, 1961. Contract AT(11-1)-795. 52p.

A test was carried out to determine the practicability and to establish quantitative requirements for unflooding of the superheater fuel assemblies by the passage of high-pressure steam through the assemblies. A full-scale BONUS subheader and superheater fuel assembly groups mockup was fabricated and its operation tested by using cold water and nitrogen at pressures above 50 psig. Data showed that a nitrogen flow rate of approximately one lb/sec at 100 psig could essentially clear a group of 4

superheater fuel assemblies in approximately one-half minute. (M.C.G.)

8364 (NMI-7243) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period September 1, 1961 through September 30, 1961. S. Isserow, R. W. Anderson, E. F. Jordan, W. J. Richmond, and W. L. Larson (Nuclear Metals, Inc., Concord, Mass.). Oct. 24, 1961. Contract AT(30-1)-1565. 15p.

An additional 1-inch tube (No. 136), extruded for the restraint program, and two previously extruded 2-inch tubes (Nos. 132 and 133) are ready for the autoclave test. The U-0.3 wt.% Al-0.5 wt.% Si experimental tube was processed through autoradiography, which showed that the cladding thickness is within specifications. A suitable facility for the heat treatment of fuel tubes was installed at the Watertown Arsenal. This facility was used for beta treatment of the three tubes for the restraint program and the U-Al-Si tube. A program was initiated to adapt established brazing techniques to the end capping for HWCTR fuel tubes. The necessary brazing equipment was assembled and its performance was demonstrated. The procedures are being refined and evaluated. (auth)

8365 (SRO-63) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT [FOR] DECEMBER 1961. (Savannah River Operations Office, AEC). 15p.

Progress is reported on developments in the AEC-AECL cooperative program, physics, engineering, metallurgy, computer program for cost optimization studies, the Heavy Water Components Test Reactor, and the Carolinas-Virginia Tube Reactor. (B.O.G.)

8366 (TID-12965) MEASUREMENT OF COEFFICIENTS OF REACTIVITY AT POWER. CORE I, SEED 2, 716.3 EFPH TO 3063.2 EFPH. Test Results T-550132-A. (Duquesne Light Co., Shippingport, Penna.). First Issue, June 2, 1961. Contract [AT(11-1)-292]. 37p. (DLCS-1510206, 07, 08, 09, 10, and 11)

Tests were carried out to determine the temperature coefficient of reactivity when the station is operating at power. The variation of this coefficient is being observed during Core I Seed 2 life. Readings of temperature, flow, pressure, rod height, and gross electrical output were recorded. The negative temperature coefficient values became increasingly more negative between 1118.0 and 3063.2 EFPH. (M.C.G.)

8367 (TID-12966) FEDAL SYSTEM OPERATION DURING STATION START-UP. CORE I, SEED 2. Test Results T-643734. Section 2. (Duquesne Light Co., Shippingport, Penna.). First Issue, May 19, 1961. Contract [AT(11-1)-292]. 20p. (DLCS-3500258 and DLCS-3500259)

Tests were carried out to determine if failed blanket fuel elements exist in the reactor core. The multiport valve was placed in the "hold" position on a designated port prior to station start-up. At the end of the test the charts were analyzed for activity bursts which would indicate possible fuel element failure. No bursts of activity were observed. (M.C.G.)

8368 (TID-13198) MONTHLY OPERATING REPORT, JUNE 1961. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 69p.

Activities are summarized covering operations, maintenance, testing and training programs, and construction at the Shippingport Atomic Power Station. (B.O.G.)

8369 (TID-14640) STATION PERFORMANCE DURING AN UNSCHEDULED POWER TRANSIENT. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First Issue, Dec. 29, 1961. Contract [AT(11-1)-292]. 15p. (DLCS-3450104 and DLCS-3450105)

Tests were carried out to collect information on station performance during an unscheduled power transient. After each of the unscheduled safety shutdowns, the operating recorder charts showing various temperatures, flows, levels, and power output were marked with the data, time, parameter, and duration of the transient. The response of the plant was determined from the traces and points printed out on these recorder charts. (M.C.G.)

8370 (WAPD-T-1367) FUEL TEMPERATURE MEASUREMENT. G. W. Hardigg and L. M. Swartz (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1961. Contract AT(11-1)-Gen-14. 89p.

Presented at Reactor School, Inst. for Atomenergi, Kjeller Research Establishment, Aug. 21-26, 1961.

The design, calibration, and operation of fuel thermocouples of the PWR core are discussed. Specific experiences are described which are useful in planning instrumentation for future reactor cores. Examples are given to demonstrate how these instruments sensed deviations from core performance prediction. Reliability, in terms of instrument drift or malfunction, is shown to be satisfactory. On the basis of the PWR experience, a summary appraisal of the capabilities of these instruments is presented. The principal objectives for improved designs are shown to be faster response time to follow the faster reactor transients and extension to the measurement of temperatures of ceramic fuels. Possible designs or techniques for the accomplishment of these objectives are discussed. (auth)

8371 (XDC-54-7-20) SHIELD DESIGN CALCULATIONS FOR AC-SERIES POWER PLANTS. T. R. Mitchell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 5, 1954. Contract AT(11-1)-171. 35p.

Shield thickness and weight calculations which were performed primarily for the purpose of furnishing trends of shield weight variation with reactor size are reported. The shield weights are not optimum largely because gamma shadow shielding at the reactor was not used in these designs. The calculation methods, which essentially are still being used for parametric type shield weight studies, are also described. (auth)

8372 (XDC-60-12-156) CORRELATION OF ZPR-III SPHERICAL FAST CRITICAL ASSEMBLIES. R. E. Reid and S. K. Breslauer (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 1960. Contracts AF 33(600)-38062 and AT(11-1)-171. 48p.

A theoretical correlation is presented of the experimental measurements made on Assembly 6F and Assembly 9A of the ZPR-III series of fast critical experiments. Both B. H. Duane's variational optimum formulation of transport theory and a standard formulation of diffusion theory were used in this correlation. Variational optimum transport theory calculations and diffusion theory calculations were made on critical mass, relative fission distributions, and U^{238} to U^{235} fission ratios. Methods were derived from variational optimum transport theory based on first-order perturbation theory to calculate the Rossi-alpha decay constant and central reactivity coefficients of materials and correlation calculations were made on these parameters. Both the transport theory and diffusion theory calculations were quite accurate for the prediction of critical mass, fission distribution, and fission ratios. The transport theory calculations were slightly more accurate, however. The correlation of the Rossi-alpha constant was quite good, while the prediction of the central reactivity coefficients

was satisfactory for some materials and unsatisfactory for others. Careful analysis of all the results of the variational optimum transport theory calculations yielded considerable insight into the inaccuracies in the calculational procedure and nuclear data. This correlation study highlighted the applicability and accuracy of variational optimum transport theory for detailed fast critical experiment correlation. It also showed that diffusion theory provided adequate critical mass predictions for fast reactors in the size range of the ZPR-III assemblies. (auth)

8373 SOME WAYS FOR INCREASING THE POWER OUTPUT OF A GAS-COOLED REACTOR. P. I. Khristenko. Atomnaya Energ., 11: 506-14(Dec. 1961). (In Russian)

The expenses resulting from the functioning of the individual components of the power station itself play an important role in the cost of the reactor-generated electricity. The largest portion is absorbed by the operating cost of circulating pumps, turbines, feed pumps and the steam generator. In the case of gas-cooled, natural-uranium fueled reactors these factors make it more economical to build high power level reactors either by increasing the dimensions of the reactor or by making use of higher fuel temperatures. In the latter case a higher utilization factor is obtained but the refractory properties of the materials used must be improved. An alternate method consists in reducing the energy expenditure of circulating the coolant and in the increase of the flow rate through the reactor. This can be achieved by providing supplementary cooling of the gas before it returns to the blower and by forming a temperature profile of the flow through the reactor. This latter method however results in an uneven burnup of the fuel elements which may cause increased thermal stresses in the central channels. (TTT)

8374 DESIGN CONCEPT OF THE A.G.R. R. V. Moore (United Kingdom Atomic Energy Authority, [Windscale Works, Sellafield, Cumb., Eng.]). Elec. Rev., 169: 774-8(Nov. 17, 1961).

The development potentialities of the gas-cooled graphite-moderated reactor have led to the construction of the Advanced Gas-Cooled Reactor at Windscale, Cumberland. The basis of its design philosophy is described and the experimental program, designed to solve the remaining uncertainties, is discussed. It is expected that civil AGR stations will reduce generation costs to 5.15 mills/kwh. (auth)

8375 THE ADVANCED GAS-COOLED REACTOR. Elec. Rev., 169: 779-92(Nov. 17, 1961).

The technical features of the Windscale Advanced Gas-Cooled Reactor are described. The reactor will use an enriched uranium dioxide ceramic fuel in stainless steel or beryllium cans and will produce 100 Mw of heat, giving a net electrical output of 28 Mw. Emphasis is given to the engineering techniques, site layout, containment building, fuel elements, fuel handling equipment, carousel, reactor, heat exchangers, circulation systems, turbo-generators, electrical connections, control and operation systems, instrumentation, test loops, and ventilation system. (N.W.R.)

8376 SOME ASPECTS OF THE NUCLEAR POWER PROGRAMME. C. W. A. Priest (Central Electricity Generating Board, [London]). Elec. Rev., 169: 793-5 (Nov. 17, 1961).

The nuclear power program of the United Kingdom is discussed with respect to future planning. One of the major planning problems is when to make the change from the magnox reactors to the advanced gas-cooled reactor. Some attention is focused on the operation and characteristics of the first six reactors of the Central Electricity Generating Board (Bradwell, Berkeley, Hinkley Point, Trawsfynydd, Dungeness, and Sizewell) and the Windscale Advanced Gas-Cooled Reactor. The economic factors also receive special attention. (N.W.R.)

8377 COOLING GAS FLOW IN A GAS-COOLED PEBBLE BED HIGH-TEMPERATURE REACTOR. W. Haug. Energie, 13: 385-8(Sept. 1961). (In German)

In continuation of an earlier work by G. Kürz, a method is shown by which the coolant gas flow for a packed tube provided with a heat source can be approximately determined under stationary conditions. The rapidly decaying process which takes places first of all inside the fuel element, but has hardly any effect on the coolant gas temperature should not be investigated, but the stationary conditions which are set up by flowing through a pebble bed with a pre-determined locally-varying heat source density. In this way a chief problem of reactor technology, the determination of coolant gas conditions by changed output as a result of changing the coolant gas diffusion, can be taken up. Such a slow change of the output can, as a result of stationary conditions, be considered constant coolant gas diffusion. Calculations are given, using the reactor dimensions and manner of notation of the previous work, from which the middle flow cross section confined to the pebbles can be drawn. The coolant gas is assumed to be helium. (tr-auth)

8378 GAS TURBINE UTILIZATION IN NUCLEAR POWER ENGINEERING. Josef Bečvář (School of Mechanical and Electrical Engineering, Plzen, Czechoslovakia). Jaderná energie, 7: 366-73(1961). (In Czech)

Developmental work done in the use of gas turbines in nuclear power engineering is reported along with some possibilities of problem solution. (auth)

8379 NUCLEAR SHIP PROPULSION. H. F. Atkins (Vickers Nuclear Engineering, Ltd., [London]). Nuclear Energy, 11-22(Jan. 1962).

The feasibility of using the steam-cooled heavy water moderated reactor for nuclear ship propulsion is discussed. The reactor is compared to the other reactors which are considered for ship propulsion—the pressurized water reactor, boiling water reactor, organic moderated reactor, and gas-cooled reactor. The economic aspects of each reactor are given along with the performance expected from each propulsion system. (N.W.R.)

8380 MAGNOX CORE PERFORMANCE ANALYSIS. R. E. Strickland and D. J. McConalogue (Imperial Coll. of Science and Tech., London). Nuclear Eng., 7: 9-11(Jan. 1962).

A single-point model is developed to represent the performance of Magnox cores on the assumptions that maximum channel output is independent of coolant flow and temperatures. Using the basic geometry and temperature data, specified comparisons of six U.K. power reactors are made. Minimization computations are also carried out for the uranium inventory of reactor cores of given outputs. The uranium inventory is regarded as a function of three independent variables, the fuel rod diameter, the lattice pitch, and the active core length. The results from these computations are used to calculate possible fuel costs. (auth)

8381 AXIAL MIDPOINT SPACERS IMPROVE EGCR HEAT TRANSFER. Richard M. Higgins and Thomas J. McDonald (Allis-Chalmers Mfg. Co., Washington, D. C.). Nuclear Eng., 7: 22-5(Jan. 1962).

A description is given of four types of axial midpoint spacer sets that may improve the heat transfer charac-

teristics of gas cooled reactor fuel elements. A test apparatus is described which duplicates the flow geometry of the proposed fuel assemblies for the Experimental Gas Cooled Reactor (EGCR). Each EGCR fuel assembly consists of a cluster of seven stainless steel tubes filled with urania pellets mounted inside a cylindrical graphite sleeve. The axis of one tube coincides with the sleeve axis; the other six tubes are equally spaced around the central tube. Each outer tube spacer has vanes (either straight or helical) and a single projecting pad. The vanes prevent tubes from touching each other; the pads prevent tubes from touching the sleeve. Central tube spacers do not have pads. The heat transfer characteristics of each type of spacer is given. An analytical correction is applied to account for the circumferential conduction of heat away from the high temperature areas through the tube material. (N.W.R.)

8382 REACTOR TECHNOLOGY IN 1961. R. F. W. Guard (Kennedy and Donkin, [London]). Nuclear Power, 7: No. 69, 65-8(Jan. 1962).

The development of various types of reactors for power generation in 1961 is discussed. The report is concerned mainly with the development programs in the United States and Great Britain; however, the progress made by other countries is also briefly discussed. The development programs are mainly concerned with the following types of reactors: gas-cooled, light water, heavy water, fast, and organic reactors. (N.W.R.)

8383 THE ENDEAVOR TO DETERMINE THE TYPE OF THE NUCLEAR REACTOR BEST SUITED TO POLISH CONDITIONS. Stanisław Andrezejewski (Inst. of Nuclear Research, Polish Academy of Science, Warsaw). Nukleonika, 6: 625-34(1961). (In French)

Studies made in Poland indicate that the heavy water-moderated organic-cooled reactor combined with steam superheater fueled with coal may best fit the need for an atomic power station. The reactor would produce high pressure steam (90 to 130 atm). The steam would be superheated and reheated to 538°C in a conventional superheater. This design would allow the use of a standard turbine from which better efficiency of coal utilization could be obtained in comparison with a conventional power station. (N.W.R.)

8384 ATOMIC POWER STATION IN CZECHOSLOVAKIA. Znanie-Sila, No. 6, 36(1961).

An atomic power station is to be built in the Bogunice locality in the town of Trnavu. The reactor will use natural domestic uranium and will have a thermal output of 590 Mw and an electrical output of 150 Mw. The primary circuit system will heat the water to 400°C at a pressure of 29 atm, and the water of the secondary circuit will be heated in the heat exchanger. Steam will enter the turbines at 180°C. The reactor control and electrical equipment will be fully automatic. The radioactive waste disposal system includes deep impervious underground reservoirs. (N.W.R.)

8385 KERNENERGIE-TECHNIK. EINFÜHRUNG IN DIE PHYSIK UND TECHNIK DER KERNENERGIE-ERZEUGUNG. (Nuclear Energy Technology. Introduction to the Physics and Technology of Nuclear Energy Production). H. Engel and K. O. Thielheim. Munich, Verlag Moderne Industrie, 1960. 300p. DM 36.

The book has the purpose of instructing the engineer and educated laity in the fundamentals of nuclear power. The physical and technical bases of nuclear power production are first reviewed. Special reactor types and their economic possibilities are discussed. In a survey of possible future developments, energy production from thermonuclear reactors is reviewed. (J.S.R.)

8386 NUCLEAR SHIP PROPULSION. Proceedings of the Symposium on Nuclear Ship Propulsion with Special Reference to Nuclear Safety, Held at Taormina, Italy, 14-18 November 1960. (International Atomic Energy Agency, Vienna). Proceedings Series. Nov. 1961. 614p. (STI/PUB/37). $10.00(IAEA).

Forty papers presented at the Symposium on Nuclear Ship Propulsion are given. Separate abstracts were prepared for 39 of the papers. The remaining paper was previously abstracted for NSA. Three of the papers are in French, the rest in English. (M.C.G.)

8387 ECONOMIC ANALYSIS OF NUCLEAR SHIPPING. J. J. Zamparo (Ansaldo S. p. A., Genoa). p.3-16 of "Nuclear Ship Propulsion." Vienna International Atomic Energy Agency, 1961. (In English)

Capital and operating costs are items which influence the design of a nuclear ship and its immediate acceptance in the merchant marine. Reactors and fuel cycles were examined and, where possible, a number of propulsion plants, designed for nuclear ships of the same type and tonnage, were compared. Sufficient data are tabulated to show the effect of certain parameters in the capital and operating costs of several nuclear systems of different power rates. The government subsidies and financial practice of some countries are mentioned. The purpose of this analysis is to give a comprehensive picture of the nuclear shipping market and its possibilities for the future. Much of the available literature was examined, and part of it is listed. (auth)

8388 MARINE NUCLEAR PROPULSION — ECONOMICS IN PERSPECTIVE. E. Norton (Yarrow and Co., Ltd., Glasgow). p.17-32 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The probable rate of progress of reactor designs toward the economic goal is discussed. From studies four things were learned: development of reactors towards lower capital cost is required to reach economic parity; steady progress in the existing technologies will bring about the development required; only two types of reactors, the water and organic reactors, are suitable and have technologies sufficiently established to have any place in any immediate plans for a nuclear ship; and there is no longer any basis on which paper studies can further advance the understanding of the present position or of the problems to be solved. (auth)

8389 SOME ASPECTS OF THE PROPULSION ECONOMICS OF MARITIME AND CONTINENTAL TRANSPORT IN YUGOSLAVIA. T. Bosanac, R. Buljan, and V. Stibilj (Inst. "Rudjer Bosković," Zagreb). p.33-50 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

On the basis of the prospective increase in goods exchange between Yugoslavia and other countries, which is reasonable for the period of the next 20 years, an attempt to determine the future development of the Yugoslav merchant marine was made. Taking into account the tonnage and consumption of fuels in 1959, the need in conventional fuels for the future merchant fleet in the same period was discussed with special reference to the domestic and import fuels basis. In order to establish the competitive conditions for the application of nuclear propulsion in the Yugoslav merchant marine, an economic study was made of merchant ships operation, and the results are given. An analysis of costs of nuclear power is made both for mari-

time and for continental transport, and break-even costs for nuclear fuels are given. The Yugoslav power situation in the period mentioned above is discussed. The percentage participation of the power necessary for merchant ships propulsion in relation to the total power output of Yugoslavia was determined. By analyzing the structure of the utilization of energy in this country, the problem of utilizers to whom the provision of electricity would be more convenient than oil fuels or coal was considered. Amounts of conventional fuels which could thus be saved are estimated. The substitution of conventional fuels of the basic continental transport by electricity from nuclear power stations and both the possibility and the opportunity of their utilization in maritime transport are discussed. An economic comparison for such a case is given in the paper and the final account of the consideration treated is made. (auth)

8390 ENEA SURVEY OF NUCLEAR SHIP PROPULSION; ACTIVITIES IN WESTERN EUROPE. L. W. Boxer (European Nuclear Energy Agency, Paris). p.51-7 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

Nuclear ship propulsion activities in its member countries were reviewed by the European Nuclear Energy Agency and of current trends in this field in Western Europe are clarified. The activities were found to constitute a number of information studies ranging over a wide variety of reactor types, which were carried out mainly by industrial concerns. In addition to this, a limited amount of research and development was done in some countries, and more is being planned, chiefly under government sponsorship. As yet there is no definite individual proposal for the immediate construction of a nuclear ship, but advanced plans exist for the construction of marine prototype reactors. The general approach to further development is cautious, this being due almost entirely to the present high cost of nuclear reactor systems currently available for application to merchant ships. The situation thus lends itself to the possibilities for collaborative action, and some steps are already being taken towards a joint program of research and development under the aegis of the Euratom Community. (auth)

8391 SURVEY OF JAPANESE ACTIVITIES IN NUCLEAR PROPULSION. M. Yamagata (Nuclear Power Ship Research Assn. of Japan, Tokyo). p.59-68 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

Shipping and shipbuilding circles have taken a growing interest in nuclear merchant ships. An outline is given of the research and development in this field in Japan during the five years since 1955. (auth)

8392 NEW REGULATIONS AND RECOMMENDATIONS APPLICABLE TO NUCLEAR-POWERED MERCHANT SHIPS. H. N. E. Whiteside (United Kingdom Ministry of Transport, London). p.75-90 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

A number of new regulations concerning nuclear-powered merchant ships are presented. As the design of nuclear reactors suitable for merchant ships is still in an early stage of development it was considered that detailed regulations covering design and construction could hamper development. It was felt, however, that some guidance should be given to governments in the application of the regulations, and a number of more detailed recommendations were agreed. The regulations and recommendations are discussed including regulations concerning the entry of nuclear-power merchant ships into ports of foreign countries. The texts of the regulations particular to nuclear-powered merchant ships and of the recommendations adopted by the conference, are included. (auth)

8393 SOME LEGAL PROBLEMS RAISED BY THE OPERATION OF NUCLEAR-PROPELLED SHIPS. A. Raspi (Ministère de la Marine Marchande, Paris). p.91-8 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In French)

When nuclear-propelled ships are put into operation, three major categories of problems must be successively dealt with. It is vital that no ship should be launched which does not meet safety standards that will ensure that accidents will be avoided so far as is humanly possible. One of the difficulties may lie in the permanent control the state issuing the license must exercise afterwards. The possibility must be considered of an accident happening despite all the safety precautions taken. The measures as regards the access of ships to roadsteads and ports, taking due account, amongst other things, of the density of population in the ports in question and the intensity of traffic within these ports are discussed. The liability of the operator and the compensation of the victims are problems which arise in case of accident. (auth)

8394 TESTING EXPERIENCE WITH THE NS SAVANNAH. B. P. Godwin (U. S. Atomic Energy Commission, Washington, D. C.). p.99-113 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The NS Savannah will be powered by a 20,000-shp pressurized-water reactor propulsion plant. The testing of the auxiliary systems, steam plant, nuclear plant, fuel loading, criticality, and power testing is described. The principal areas of emphasis on pre-critical and critical testing of the propulsion system are presented. The prototype nature of the ship and the data and performance information which were compiled during this phase of the Savannah's life are discussed. Brief reference is made to the crew training program as it was affected by the testing and qualification period. Necessary regulatory requirements, preparation of reactor safeguards, safety assessments, and prerequisite inspections are outlined. The methods employed in testing the nuclear plant, the preparation of test memoranda and procedures, together with the results and findings of this method of testing installed prototype nuclear plants are discussed in detail. The results of environmental studies and the organization for initial testing and subsequent seagoing operation are stressed as they impinge upon the over-all program objectives. (auth)

8395 SOME SAFETY CONSIDERATIONS OF NUCLEAR PROPULSION PLANTS IN SHIPS. J. M. Pawlikiewicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.115-20 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 3302.

8396 SAFETY OF NUCLEAR SHIPS. C. K. Beck and E. G. Case (U. S. Atomic Energy Commission, Washington, D. C.). p.127-34 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

Threats to public health and safety do not ordinarily arise out of the routine operation of nuclear ships but rather due to the possibility of internally and externally caused accidents to these vessels. To minimize the possibility of such accidents and to prevent the release of

dangerous amounts of radioactivity, a variety of special safeguards in design, construction, and operation can be provided. Examples of design safeguards include a conservatively designed reactor system to give dependable and reliable power for the propulsion system, adequate alternate normal and emergency power sources, a conservatively designed and sized waste-storage and disposal system, containment of the reactor and its vital systems, location of the reactor system in that portion of the ship least vulnerable to collision damage, special collision protection, etc. When a nuclear ship is carefully designed with such safeguards, constructed to high standards in materials and workmanship and is operated by a competent and well supervised crew, it is believed that the likelihood of accidents that would cause serious radiation damage to people and property is exceedingly small despite the mishaps that befall seagoing vessels. (auth)

8397 CLASSIFICATION STANDARDS FOR NUCLEAR-POWERED SHIPS. B. Hildrew and J. McCallum (Lloyd's Register of Shipping, London). p.135-49 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

Safety requirements additional to those normally associated with shore nuclear installations or conventionally powered ships, which a classified nuclear ship must satisfy are indicated. Such requirements are designed to cover all foreseeable reactor types suitable for marine use in the coming decade. The quality of material to be used in the hull is specified and the basic requirements relating to the longitudinal strength of the ship structure are outlined. Protection against collision and grounding is discussed and the extent of protection required is indicated. The basic principles relating to the support of the containment vessel within the ship are postulated, and the location of the reactor is considered with particular reference to ship handling and design. The design conditions for all categories of pressure vessels are briefly stated, and the parameters of the major accident for which the containment vessel is to be designed are detailed. Ship motion and external shock loading are discussed in relation to the design of the reactor components and associated supports. Acceptable maximum accelerations are proposed. Guidance is given to permit acceptable design of pressure relief systems for primary and secondary circuits. The design requirements consequent upon installation in a marine environment are stated in a brief survey of reactor engineering, reactor control and decay-heat removal. Supplementary installation requirements covering shielding, defuelling, effluent disposal, and electrical supplies are also discussed, but only where the marine environment influences the particular subject. The requirements for survey and maintenance of the major items of hull and reactor machinery are outlined, together with details of the periodic tests required and the probable time scale for inspection. A discussion is included on particular items which, it is suggested, are subject to further rationalization, but require experimental proof to permit relaxation of the requirements outlined. Such items are: major accident parameters, containment, choice of reactor materials and secondary shielding. It is suggested that the safety and consequently the economic potential of any system is dependent upon a greater understanding of these problems. (auth)

8398 PROSPECTS OF FRAMING REGULATIONS GOVERNING CLASSIFICATION OF NUCLEAR-PROPELLED SHIPS. G. Bourceau, R. Mattéra, and P. Weiss (Bureau Veritas, Paris). p.151-79 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In French)

The groundwork available for undertaking the study of regulations governing nuclear-propelled merchant ships consists of the construction and safety rules established for conventionally propelled ships, and of the experience gained in the operation of nuclear power stations. The main difficulty resides in the rapid development of technology, the diversity of solutions proposed, the entirely novel character of most of the problems at issue, and, in particular, in the very high potential risks occasioned by the presence on board of a large quantity of highly radioactive products. These considerations are believed to involve the provision of regulations governing nuclear marine engines which may, in a few years' time, prove too strict, on certain points at least, but which are at present necessary in order to minimize the risk of serious accident while not placing commercial operation at too much of an economic disadvantage. Such rules should be centered round the following main points: quality of design and construction of equipment, reactor control systems, reactor cooling system, and special measures to minimize the consequences of accidents at sea. (auth)

8399 EVALUATION OF RULES AND REGULATIONS FOR NUCLEAR SHIPS. N. Krarup (Danatom, Hellerup, Denmark). p.181-9 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

An evaluation is given of trends in the sphere of rules and regulations for nuclear ships as they appear from published rules, approved projects, etc. (auth)

8400 PORT ENTRY CONTROL AND SAFETY ASSESSMENT PROVISIONS OF THE 1960 SOLAS CONVENTION AS APPLIED TO THE NS SAVANNAH. C. P. Murphy (U. S. Coast Guard, Washington, D. C.). p.191-6 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The port acceptance, and control arrangements as proposed in SOLAS Convention draft and their application to the international program of the NS Savannah are discussed. For the implementation of the Convention in countries where there is extensive atomic energy development a Safety Assessment would normally be evaluated by the same groups responsible for nuclear safety in that country. When a Safety Assessment is received by a country where there is no nuclear energy development the authorities will know that the ship was carefully inspected, tested, and approved by the authorities of the Flag country. In addition, the acceptance of the Safety Assessment by one or more countries who have conducted their own independent evaluation could well be a sufficient indication that it would be safe to permit the ship to enter port. It would appear desirable for IMCO and IAEA to be kept informed as to the decisions taken by various governments with respect to a particular ship in order that they could serve as central sources of information. The NS Savannah Safety Assessment will comply with the procedures established by the 1960 SOLAS Conference. The first (Engineering and Construction) and the fourth volumes (Analysis of Hypothetical Accidents) were prepared while the two others will not be issued until sea trials and some experimental operations have provided additional data. (auth)

8401 SOME SAFETY PROBLEMS IN THE FIAT ANSALDO NUCLEAR SHIP STUDY. L. Chinaglia and P. Rucci (FIAT, Turin). p.209-27 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

Some typical problems concerning the Fiat Ansaldo study of a 50,000-ton dead-weight nuclear tanker are discussed. Particular emphasis is given to the basic safety arrangements of the plant. The solutions proposed for this project are compared with the corresponding ones adopted in other nuclear ship proposals. Finally, there is presented an over-all review of the present design philosophy enhancing the pre-eminent importance of the safety aspects in commercial nuclear ship propulsion. (auth)

8402 METHOD OF SAFETY ANALYSIS OF A STEAM-COOLED MARINE REACTOR. S. G. Bauer and M. H. Kendon (Rolls-Royce, Ltd., Derby, Eng.). p.229-39 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The reactor considered is of the pressure-tube type moderated by heavy water at atmospheric pressure. The fuel elements are uranium-oxide pellets clad in stainless steel and are cooled by dry steam at 55 atm. Safety analysis begins with the determination of scram sequence and methods of long-term decay-heat disposal. A series of severe credible accidents are analyzed in turn and the one with the most serious consequences for the particular system is established. In this case a sudden break of the reactor steam-main is the worst condition. It is demonstrated that under these most severe conditions there are serious temperature transients, but that reactor parameters can be so chosen that no melting of fuel elements will occur. This leads to a plant layout which does not require shielding round the containment. Next, credible accidents are analyzed to establish the maximum pressure the containment structure may have to withstand. This includes detail analysis of time sequence of pressure build-up together with the heat transfer problems involved. Alternative methods of containment design are also discussed. After the major accident problems, operational hazards are analyzed. Sources of coolant activity are investigated. In this case activation of coolant or corrosion products is small compared with activity arising from defects in fuel cans. Permissible leak rates from the coolant circuit are then determined and it is shown that activity leakage is limiting only in the direct-cycle application. (auth)

8403 SAFETY ASPECTS OF THE MARINE ADVANCED GAS-COOLED REACTOR. J. J. O'Neill and M. C. Hartnell-Beavis (General Electric Co., Ltd., Erith, Eng.). p.241-59 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

Two aspects of a nuclear power unit which are of particular importance in a marine application are the over-all size and weight and the safety of the installation. In order to reduce the size and weight of a gas-cooled graphite-moderated reactor to proportions suitable for marine power units, it is necessary to increase the fuel rating substantially above that hitherto proposed for land-based installations. A practical fuel-element design, using uranium oxide canned in stainless steel, suitable for high ratings, was proposed and is incorporated in a new design of propulsion unit which is briefly described. The safety aspects of the design are discussed. The principal hazard associated with a nuclear reactor system is the release of radioactive products. Since the only effective means of releasing large quantities of radioactive matter is through melting of the canning materials, the main considerations for a core safety study relate to the maximum can temperature and the conditions under which cans could melt. In the cases where it is likely that cans could melt, consideration is given to the possible release of the subsequent active gas to the containment vessel. A further hazard which might be produced is that of excess pressures in parts of the system, in particular the containment system, leading to failure of such parts. Such a fault might produce widespread structural damage to the ship, without release of activity. (auth)

8404 CONTROL AND INSTRUMENTATION OF THE ORGANIC REACTOR PLANT IN A NUCLEAR POWERED SHIP. W. Smith and E. A. Ryder (Hawker Siddeley Nuclear Power Co., Ltd., Slough, Eng.). p.283-98 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The control and instrumentation of an organic-moderated and cooled reactor is discussed with special reference to safety precautions. A system is proposed which is considered to be a logical compromise between operational flexibility and safety, with maximum reliability. The basis of the analysis is an analogue computer study on the results from which the decisions regarding the selection of control rod rates, trip settings, operating procedures and operational availability may be taken. A discussion is given of the mathematical model of the system and the validity of the assumptions made. Results of representing various operating procedures and fault conditions are given, with a discussion of the selection of safety devices and instruments. Emphasis is given to faults arising from ship and sea-going reasons rather than from incidents originating in the reactor. (auth)

8405 INVESTIGATIONS ON THE SAFETY OF AN OMR SHIP REACTOR. O. Knecht and H. Mausbeck (Interatom Internationale Atomreaktorbau G.m.b.H., Bensberg, Ger.). p.299-310 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

A brief description is given of an OMR marine propulsion system, with special regard to constructional safety measures. Fuel elements, control rods, the emergency cooling system, and the containment of the primary system are discussed in particular detail. Results on the dynamic behavior of the plant without automatic control under maneuvering conditions are given, and it is shown that even in this case normal rates of load change can be achieved. Of the reactor accidents commonly dealt with and of the safety measures required, particular emphasis is placed on those which are of special significance in connection with a maritime plant. A pipe rupture in a heat exchanger and leaks in the primary and secondary loops are discussed. Among the safety measures special emphasis is placed on keeping the containment intact and on maintaining the emergency cooling system in operation, even after the ship has sunk. Methods of controling quantities of radioactivity released during reactor accidents are described. It was concluded that the design provides adequate safety for the maritime application. In order to avoid design complications associated with fuel changes at sea, the reactor is required to operate with a certain number of damaged fuel elements. The extent of permissible damage for the OMR was investigated on condition that the activity concentration in the waste gases and the dose rates aboard ship should not exceed permissible limits. The results of these investigations are presented. (auth)

8406 THE EFFECT OF DIRECT-CYCLE OPERATION OF A MARINE BOILING-WATER REACTOR ON THE SAFETY OF THE SHIP AND THE CREW. H. J. Bruechner (Allgemeine Elektricitäts-Gesellschaft, Frankfurt am Main). p.311-24 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

If a ship is to be equipped with a boiling-water reactor propulsion system, the decision must be taken whether the

direct or the indirect cycle shall be used. Whereas the indirect cycle suffers from the disadvantage of greater weight and space requirement, poorer efficiency and hence poorer economics, the direct cycle suffers from the fact that active steam is fed directly from the reactor to the propulsion turbine. The appropriate measures that must be taken in order to warrant the safety of the ship and the crew under normal and certain possible accident conditions in face of this fact are discussed. These measures include particular arrangements of nuclear plant equipment in the ship, special turbine and condenser design, provision of the special purification system for the active condensate, additional shielding, remote control of the turbine, and certain regulations with respect to the operation of the propulsion plant. (auth)

8407 ON THE BEHAVIOUR AND TESTING OF MARINE BOILING-WATER REACTORS. J. Wilhelmsen, Jr. (Institutt for Atomenergi, Kjeller, Norway). p.325-33 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

A study of marine boiling-water reactor dynamics is described and the reactor's response to ship movement in a seaway is indicated. Comments are made on the characteristics and the advantages of a marine boiling-water reactor test facility of the "Rock'n Roll" type. (auth)

8408 FURTHER STUDIES ON THE NUCLEAR-POWERED SMALL EXPERIMENTAL SHIP. M. Yamaguchi, T. Naganuma, Y. Fujise, and H. Shimabara (Mitsubishi Shipbuilding and Engineering Co., Ltd., Tokyo and Mitsubishi Atomic Power Industries, Inc., Tokyo). p.335-52 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

In September 1959, a nuclear-powered small experimental ship, having a displacement of 4100 tons gross, was recommended to the Japan Atomic Energy Commission as one of the suitable types of ships to be built first. The pressurized-water reactor has a 30-Mw heat output and was calculated to give 8000 shp net. Further studies were made concerning the safety problems of the small experimental ship concept. The modified principal particulars of this ship are described. The values calculated on the Japanese standard for the subdivision of a passenger ship are such as to guard against damaged stability and flooding. The collision barrier of the reactor compartment is discussed with reference to Minorsky's paper. Preliminary designs of the reactor core and the reactor control and safety system are surveyed, and the outline of biological shielding is illustrated. (auth)

8409 THE SHIELDING OF MARINE REACTOR INSTALLATIONS. J. Brown and A. Jackson (United Kingdom Atomic Energy Authority, Risley, Eng.). p.359-77 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The reactor shielding problems peculiar to marine installations, including such factors as shielding weight and its support by a flexible hull structure are discussed. The implications of the requirement that the ship's crew must necessarily work and live in close proximity to the reactor for long periods are considered. The special shielding requirements to permit normal port operation and ship repair work are described. The differences between the shielding requirements for ships of various types are also discussed. The relative engineering and economic advantages of alternative materials for primary and containment/secondary shielding are reviewed. (auth)

8410 THE THEORETICAL PREDICTION OF NEUTRON PENETRATION IN SHIELDS FOR MARINE REACTORS. A. Avery (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.379-87 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The methods available for the prediction of neutron penetration in marine shields are briefly reviewed. The multigroup method which is used in the shield design of the United Kingdom nuclear-power stations was modified to make it suitable for calculating the neutron fluxes in typical marine shields. The modifications are described and the predictions of absolute thermal neutron flux are compared with measurements for several iron-water shield configurations. (auth)

8411 NEUTRON FLUXES IN A METAL WATER SHIELD: A COMPARATIVE STUDY. S. J. Thunell (Aktiebolaget Götaverken, Gothenburg, Sweden). p.389-402 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

A comparison was made between the results of three different methods for computing the neutron fluxes in a metal-hydrogen radiation shield. The shield in question is the primary shield for the NS Savannah reactor and the first calculation method was used by Babcock and Wilcox, in their design of the shield. The second method utilized a one-group removal theory for the fast flux and a two-group diffusion theory for the intermediate and thermal fluxes. The third method is similar to the second but utilizes an 18-group removal concept together with a 6-group diffusion theory. The computation work in the last two methods was carried out on a Ferranti Mercuri Computer placed at AB Atomenergi, Stockholm. The methods are described and the most important shield member data are given. The neutron flux profiles derived are grouped together in diagrams showing total epithermal fluxes and thermal fluxes and finally the discrepancy between the results is discussed. (auth)

8412 STUDY OF VAPOUR SUPPRESSION FOR THE CONTAINER OF A NUCLEAR-POWERED SHIP. K. Kono and N. Omori (Mitsubishi Shipbuilding and Engineering Co., Ltd., Tokyo and Mitsubishi Atomic Power Industries, Inc., Tokyo). p.403-415 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The installation of a container in a nuclear ship poses very difficult problems since the internal pressure applied to the marine container when flash phenomenon occurs due to accident with a water-moderated reactor is remarkably higher than that of the container for land use because of the limited available space in a ship. Therefore, one of the most important problems from an economical viewpoint is to reduce internal pressure and develop a container which is safe and easy to install. It is most desirable to use a part of the hull structure as a container. Out of many methods for reducing internal pressure, the most attractive is to condense flashed steam with the submerged nozzle and collect it in a water pool, that is, the vapor-suppression system, which does not require the use of any other mechanical equipment during an accident. This consists of the primary system including the reactor, the container, the submerged nozzle, the water pool, and the gas storage tank for storing radioactive gas. The effectiveness of the vapor-suppression system was examined by analyzing the effects produced on the transitional state of the container and the gas storage tank by the quantity of steam flowing from the primary system into the container, the total area of the ports for the passage of a mixture of air and steam out of the container, and the ratio of volume between the container and the gas storage tank. According to

the results obtained, if the quantity of flashed steam per volume of the container is reduced or if the area of the ports for passage of a mixture of air and steam per volume of the container is increased, the internal pressure can effectively be reduced, and the latter is more effective for the nuclear-powered ship. To put this system into practice, the results of the analysis must be substantiated by experiments. For this purpose, experiments are being made on pressure-reducing by this system with the use of a model. (auth)

8413 EFFECTS OF SCRAM ON MANOEUVRABILITY. M. Muysken (Reactor Centrum Nederland, The Hague). p.417-21 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

One of the aspects of the safety of nuclear ships which deserves further consideration is the possibility of a reactor scram when the ship is maneuvering, or sailing in confined waters, or otherwise in a condition that a loss of power is very unwelcome. Considering nuclear ships with only one reactor installed there will be a relatively short period after a scram during which there will be some power available from the latent heat in the installation. During this short period following the scram the commanding officers must decide whether to switch to the emergency power supply, with necessarily a limited amount of total power available for further maneuvering, or else, to await a possible return to power from the reactor within a reasonable period, so that all effort must be directed to bringing the reactor back to power. Some of the many factors which must be considered in such a situation are discussed with an estimate of the periods of time involved. (auth)

8414 RESEARCH INTO OPTIMUM MANOEUVRABILITY. L. Peffau, J.-C. Lény, and A. Grill (Commissariat à l'Energie Atomique, Paris and Marine Marchand, Paris). p.423-31 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In French)

The nuclear ship, like the conventionally propelled vessel, will be the subject of conflicting claims as between safety and profitability. At the present stage of atomic propulsion, the prototype stage, safety considerations take precedence over others. Maneuverability is one of the safety factors. Among the circumstances in which power variations in the propulsion plant arise, two demand the particular qualities characteristic of maneuverability: brusque reversing motions, and handling of the vessel in port. A dynamic behavior pattern in propulsion plant is revealed by a study of each of these cases. By adopting as a basis the results of an inquiry into the real needs of present-day conventional vessels, an appreciation of acceptable safety factors can be attempted. By comparison with high performance programs, such new evaluations imply advantages, which in the technical sphere take the form of simplification and robustness of equipment and facility in operation, affecting particularly the regulation and control system and the primary circuit gear. To these must be added a definite easing of demands on crew skill. The sum total of these advantages is therefore conducive to safety, viewed from its longer-term aspects. They may also be applied to another sector of the general constituent safety of the ship, thus facilitating the search for a harmonious equilibrium between the various sectors. (auth)

8415 ON THE EXTERNAL FORCES OF SEA-WATER ACTING ON MARINE REACTORS AS MEASURED IN TESTS ABOARD THE MS HODAKASAN-MARU. I. Uchida and H. Yamaguchi (Mitsui Steamship Co., Ltd., and Mitsui Shipbuilding and Engineering Co., Ltd., Tamano City, Japan). p.443-59 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

Nuclear power plants installed on ships must be such as to ensure safe operation despite all the external forces arising from the motions of ships in heavy seas. In designing reactors for ships, therefore, the assessment of acceleration affecting various parts of ships is one of the most essential problems that must be solved. Generally speaking, analyses of accelerations, that is, the magnitudes and statistical distribution of these external forces, may be obtained by means of model tests. They cannot, however, be relied upon and applied by engineers in designing reactors. Data obtained under a wide range of actual operation conditions would be of utmost value in solving the design problems. During three winters since 1957, a series of tests and measurements of accelerations aboard the MS Hodakasan-Maru, a high-speed cargo liner of the Mitsui Steamship Company, were carried out in the North Atlantic and Pacific Oceans. In the first tests, measurements were taken of the accelerations due to slamming of sea-water on the voyage from Europe to North America when the vessel was in ballast. Measurements of stress on forward bottom panels, bow accelerations, stresses on midship upper decks, pitching angles, rolling angles, etc. were taken and recorded in conjunction with corresponding conditions of the sea. About 250 slammings were measured at various speeds and in different conditions of swells. In the second tests, further attempts were made to gather additional information and data on various accelerations experienced by ships in heavy seas. These took place on board the same cargo liner on her eastbound round-the-world voyage when she was proceeding in various loaded conditions. For this purpose, arrangements were made to take measurements of accelerations at a number of places on the upper deck of the vessel, in addition to those taken at the locations in the first test. Magnitudes of accelerations and their distributions on the ship were taken and recorded at various speeds and in different sea conditions. These records, used in conjunction with statistical analyses, should enable designers to determine the locations of reactors on vessels, and assess the magnitudes of accelerations from external forces acting upon them. Third tests were continued to augment information and data along these lines. (auth)

8416 ON THE TESTING OF STRUCTURAL MEMBERS OF SHIP REACTORS UNDER SIMULATED CONDITIONS ON BOARD SHIP. D. Ulken (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg). p.461-75 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The influences of the sea motion and the vibrations of machines cause additional high stresses on the structural members of a ship reactor. To achieve the required high safety in operation it is necessary to test new constructions prior to their installation in ships. It is intended that the functions of control-rod drives and the durability of control rods and fuel elements for nuclear ship propulsions undergo thorough testing on an appropriate test-stand. One of these test-stands, a so-called 'rolling-stand,' will be able to simulate ship motions both at sea and in the case of accidents (collisions and so on). On the rolling-stand measuring and control instruments are tested as well as test-loops. Alongside these experiments with oscillations of low frequency, further tests with higher frequency on the same objects will be carried out by means of another vibration test-stand. The particulars of the results of both test-stands are reported. These particulars were arrived at with the help of both the results of measurements taken on several ship voyages and with that of experts' reports. The possibilities for the drive and the design of the rolling-

stand are discussed and compared critically. The intended design for construction is described. (auth)

8417 WAVES AND SHIP MOTION DURING A STORM. M. Winsnes (Institutt for Atomenergi, Kjeller, Norway). p.477-83 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

There is a discussion of the formation of waves and the wave spectrum. Some probability relationships are mentioned. The coupling between the waves and the ship is described. The behavior of a ship in the waves is outlined. (auth)

8418 RESEARCH ON THE COLLISION-RESISTING CONSTRUCTION OF SHIPS' SIDES. K. Kagami, T. Hamada, R. Tsunoda, H. Ohi, and T. Harima (Yokahama Shipyard and Engine Works, Yokohama, Japan and Mitsubishi Nippon Heavy-Industries, Ltd., Yokohama, Japan). p.485-502 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

In order to assure the safe operation of a nuclear ship, full protective measures must be taken in advance against possible accidents. From this viewpoint, the protection of the nuclear reactor against accidents due to a collision of the ship is a most important problem. Research was carried out to discover what kind of shipside construction of a nuclear ship would be effective to minimize the damage caused by a collision if the bow of another ship comes into contact with the ship's side where the nuclear reactor room is located. The research was carried out by $1/20$ model experiments of the construction of the nuclear reactor room of a 45,000-dwt nuclear tanker, which is one of projected nuclear ships in Japan. The experiment was conducted sixteen times including the preliminary ones. However, nine experiments (on eight kinds of construction models) were conducted for analysis. Throughout all the experiments the speed of the collision was arranged to be about 5 knots, and the model of the bow was of the same construction. For the model of the ship side construction, eight kinds of constructions were considered effective for collision-resisting. Moreover all were designed on the basis of the same weight. From the experiments, an effective collision-resisting construction of the ship sides by measuring the extent, stress, impact force, etc. of the failure of this construction and that of the bows could be ascertained. The result of these experiments proved that for protective construction it is effective to increase the thickness of the shell to a reasonable degree. This fact is considered to be significant in designing a collision-resisting construction. (auth)

8419 MAINTENANCE PLANNING FOR NS SAVANNAH. R. O. Mehann and D. F. Bolender (States Marine Lines, New York). p. 507-13 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The NS Savannah was designed for an estimated reactor core life of approximately 3.5 years. The organization and planning being done in order to minimize reactor downtime and delays in job progress in the event that the reactor is shut down before its normal expected fuel burnup because of equipment or core failure or to install improved equipment is presented. Proposed methods of performing the most likely maintenance tasks are discussed. These include the tasks associated with refuelling the reactor and such items as removal from the containment vessel and replacement of faulty pumps, valves, heat exchangers, etc. Special equipment was designed and constructed to facilitate removal and replacement of the reactor fuel elements. Salient design features of the equipment and the proposed methods of using the various components are presented. Necessary crane lifts and special shipyard facilities required for performance of the major Savannah maintenance jobs are outlined. Design and procedural features for nuclear safety and personnel protection from radiation are stressed. Ideas on the handling and disposing of radioactive wastes are briefly discussed. Included is a description of the nuclear servicing vessel Atomic Servant and its functions. It was constructed for use as a servicing ship for the Savannah and contains a spent fuel pit for storage of fuel before shipment to a processing site, and necessary equipment for processing the solid and liquid radioactive or contaminated wastes generated by the Savannah. Methods of disposal of wastes and the design features of the equipment are presented. (auth)

8420 THE REFUELLING OF NUCLEAR-PROPELLED SHIPS. R. Anscomb, R. O'Neil, and J. A. Dodd (United Kingdom Atomic Energy Authority, Risley, Eng.). p.515-31 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The economic, engineering, and safety considerations associated with the refuelling of nuclear-propelled ships are discussed. The economic analysis takes into account such factors as refuelling cycles and their influence on fuel costs and demurrage charges. The engineering section reviews alternative methods of refuelling and their influence on the operational flexibility of the ship and the capital costs of the ship and its support facilities. The safety discussion considers the relative risks of an environmental hazard developing from faults or accidents with the refuelling equipment using the alternative methods discussed in the engineering section. Arising from this, proposals are made as to the relative siting restrictions which might have to be imposed to ensure comparable degrees of safety using the various methods. (auth)

8421 SURVEY OF WASTE-DISPOSAL PROBLEMS IN NUCLEAR SHIP PROPULSION. C. Roberts (International Atomic Energy Agency, Vienna). p.539-44 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The operation of nuclear-propelled ships should not constitute a problem from the view-point of waste disposal. Procedures to ensure that this is a fact are now being developed and equipment to accomplish it is being designed, so this is the most effective time for action in regard to its control. Wastes of low and intermediate activity may safely be disposed of into the sea under controlled and specified conditions where a careful evaluation is made of future consequences and in particular of any international implications. The nature of the wastes, the potential problems associated with their release, and means of providing for their safe disposal are discussed. Some arrangements being undertaken by the IAEA to aid in evaluating this and other waste-disposal problems in the sea are presented. Technical studies and factors to be considered in waste control of nuclear propelled ships are described. (auth)

8422 ACCIDENTAL ACTIVITY RELEASE FROM NUCLEAR SHIPS. W. B. Cottrell, L. A. Mann, F. L. Parker, and G. D. Schmidt (Oak Ridge National Lab., Tenn.). p.545-59 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The results are described of an analysis by ORNL of the theoretical consequences of reactor accidents that might

associated with the NS Savannah. Mobile nuclear power plants, like their stationary land-based counterparts, must be designed with due consideration to possible exposure that could result from various nuclear incidents. As with

stationary power plants, one may define various accidents and then establish the exposure which should not be exceeded in each case. Those responsible for nuclear safety are still striving to arrive at upper limit values for such exposures for stationary power plants, but it may be expected that the same criteria apply to nuclear ships. Nuclear ships, furthermore, differ from their land-based counterparts in at least two significant aspects which have an important bearing upon the safety features provided with the nuclear plants; namely, the proximity of the nuclear installation to passengers as well as to population centers (when in most any harbor), and the possibility of activity release to the hydrosphere. As was suggested by ORNL in the case of the NS Savannah, both the maximum individual public exposure and the total public exposure from the maximum hypothetical accident in which the activity is released to the atmosphere must be limited to some predetermined values in order to restrict adequately the consequences of the accident. Values of 25 rem (total body) as were suggested by ORNL and 2×10^6 man-rem (total body) were suggested by the Advisory Committee on Reactor Safeguards as being appropriate. The application of such exposure criteria to nuclear ships virtually dictates that the activity which escapes from containment system during the maximum credible accident must be released at an elevated level. Since double containment is generally necessary to prevent excessive activity releases, the additional requirement of an elevated release would require either an additional ventilated compartment, as in the NS Savannah, or the adoption of some form of secondary containment from which the released activity may be directed up a stack. In any event, it is desirable to have sufficient control of the released activity so that it may be filtered to some predetermined decontamination factor and released at some predetermined height. Should the maximum hypothetical accident occur with the vessel submerged, it may be presumed that the activity would leak into the surrounding water. In this event, there would probably be a concentration of activity in the water, beyond the immediate vicinity of the ship, of less than the mpc for continuous occupational exposure and such a concentration would generally be acceptable. The acceptable concentration, however, may vary with the usage of the water in a particular harbor and the duration of the high concentration. (auth)

8423 SAFETY CONSIDERATIONS ARISING FROM THE OPERATION OF NUCLEAR MERCHANT SHIPS IN PORTS. G. D. Bell (United Kingdom Atomic Energy Authority, Risley, Eng.). p.565-73 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The nature of the hazards which may arise from the operation of nuclear ships in ports was considered both in routine operation and in accident conditions. The potential hazards to the surrounding population and environment are discussed and the implications, both on design and operation of the ship and on the desirable characteristics of a port are examined. (auth)

8424 SAFETY ON SHORE IN RELATION TO THE OPERATION OF NUCLEAR SHIPS IN HARBOURS. J. Thomas and O. Kofoed-Hansen (Forsøgsanlaeg Risø, Roskilde, Denmark). p.575-83 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

A discussion is given of the philosophy leading to the concept of a safety distance of a reactor on land and of the influence of placing the reactor on board ship in harbors. (auth)

8425 EVALUATION AND CLASSIFICATION OF PORTS WHICH ARE LIKELY TO BE WANTED AS PORTS FOR NUCLEAR-POWERED SHIPS. N. Wie. p.585-8 of "Nuclear Ship Propulsion." Vienna, International Atomic Energy Agency, 1961. (In English)

The regulations concerning nuclear ships included in the 1960 SOLAS Convention are discussed. In view of the fact that nuclear ships will have to call at ports, the need arises for an evaluation of these. The characteristics must be considered with a view to classifying their suitability as loading or discharging ports. In Norway, a nuclear-powered ships Safety Committee was officially appointed to carry out such an evaluation and classification of the main Norwegian ports. A number of characteristics and aspects related to each port are listed and discussed. (auth)

8426 DEVICE AND METHOD FOR PRODUCING POWER. (to U. S. Atomic Energy Commission). British Patent 886,874. Jan. 10, 1961.

A boiling reactor is designed which relies on bubble formation within the core and on resonance absorption of neutrons in U^{238} to provide inherent stability. The steam-forming coolant is circulated by convection, and the moderator, which may be H_2O or D_2O, is prevented from forming bubbles. (D.L.C.)

Research Reactors

8427 (ANL-6192) HAZARDS SUMMARY REPORT ON THE JUGGERNAUT REACTOR. J. R. Folkrod, D. P. Moon, and J. F. Saluja (Argonne National Lab., Ill.). Feb. 1961. Contract W-31-109-Eng-38. 79p.

The Juggernaut is a light-water-cooled and moderated, graphite-reflected, heterogeneous thermal reactor designed to provide experimental facilities for conducting basic research in the neutron flux range to 4×10^{12} n/cm^2/sec at an operating power level of 250 kw(t). Pertinent design and operating characteristics are tabulated. Evaluations are made for potential hazards posed by certain hypothetical major accidents during the operation, and the adequacy of the safeguards provided to insure that the health and safety of personnel, within and beyond the site boundary, are not unduly endangered. The results indicate that in the event of any conceivable reactivity increase, auxiliary and inherent safety features peculiar to the Juggernaut will operate to insure automatic shutdown through a nondestructive BORAX-type process. (B.O.G.)

8428 (BLG-66) CALCULATIONS OF CROSS SECTIONS AND BURNUP FOR THE BR3. A. W. Eitz (Brussels. Centre d'Etude de l'Energie Nucleaire). Mar. 1961. 90p.

Using the Ferranti-Mercury digital computer, effective thermal and epithermal absorption and fission cross sections for the core of the BR3 were calculated depending on the form of the neutron spectrum. Applying these cross sections, burnup calculations were made taking into account the spectrum variation in the course of the burnup. For all calculations constant moderator temperature and constant thermal output of the reactor were assumed. (auth)

8429 (IDO-16724) HEAT EXCHANGER TUBE FAILURES IN THE ETR. O. M. Hauge and G. W. Gibson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 8, 1961. Contract AT(10-1)-205. 19p.

During Cycle 39 four stainless steel tubes installed in one of the twelve ETR primary heat exchangers failed through the mechanism of fatigue cracking. The possibility

of chloride stress corrosion prompted complete tube removal to facilitate detailed metallurgical examinations of the austenitic tube material. The apparent tube vibrations leading to the ultimate failures caused a re-evaluation of primary and secondary cooling system operation in an effort to reduce water velocities on the shell side of the heat exchangers. (auth)

8430 (TID-14771) PRELIMINARY HAZARDS SUMMARY REPORT ON THE BROOKHAVEN HIGH FLUX BEAM RESEARCH REACTOR. J. M. Hendrie and H. J. C. Kouts (Brookhaven National Lab., Upton, N. Y.). May 1961. Contract AT-30-2-GEN-16. 249p.

The High Flux Beam Reactor, HFBR, is cooled, moderated, and reflected by heavy water and designed to produce 40 Mw with a total epithermal flux of $\sim 1.6 \times 10^{15}$ cm^{-2} sec^{-1} and a reflector thermal maximum flux of 7×10^{14} cm^{-2} sec^{-1}, using a core formed by ETR plate-type fuel elements in a close-packed array. The hazards summary is given in terms of site description, reactor design, building design, plant operation, disposal of radioactive wastes and effluents, and safety analysis. (B.O.G.)

8431 (JPRS-10872) DETERMINATION OF THE GEOMETRY OF THE TECHNOLOGICAL CHANNELS OF THE SECOND POLISH RESEARCH REACTOR. W. Frankowski, E. Kmiotek, J. Mika, A. Strupczewski, and A. Zmyslowski. Translated from Nucleonika, 6: No. 3, 181-96(Mar. 1961). 17p.

The computational methods and results used to determine the fuel element geometry in the Second Polish Research Reactor are described. The fuel element selected uses 20%-enriched U with a total of 250 g of U^{235}, arranged in 3 concentric, Al-clad, water-cooled tubes. (auth)

8432 STUDY OF THE BR-5 FAST REACTOR. (SPATIAL AND ENERGY DISTRIBUTION OF NEUTRONS). A. I. Leipunskii, A. I. Abramov, Yu. A. Aleksandrov, et al. Atomnaya Energ., 11: 498-505(Dec. 1961). (In Russian)

The 5000-kev BR-5 Fast Reactor is used for obtaining the data needed for the design of high-power fast breeders. The reactor is fueled with Pu oxide and it uses Na as heat transfer agent; a double layer of natural U and Ni serve as reflector. The reactor is provided with experimental devices such as beamholes and a thermal column which are needed for the experimental program in nuclear physics. A loop through the vertical axis of the core is used for fuel element studies; two horizontal fast neutron beamholes penetrate through the reflector and the shield; another beamhole used for work with intermediate neutrons starts at the Ni reflector while a large hole is used for shielding tests. In view of the problems presented by the neutron spectrum measurements only the relatively fast neutrons ($E_n > 50$ kev) were studied. The cross sections of the $U^{238}(n,f)$, $Th^{232}(n,f)$, and $Al^{27}(n,\alpha)$ reactions with effective thresholds of about 1.4 and 5 Mev, and of the $Pu^{239}(n,f)$, $Na^{23}(n,\gamma)$, $Cu^{63}(n,\gamma)$, and $Au^{197}(n,\gamma)$ were investigated. The Au indicators were used for studying the soft portions of the spectrum. The dimensions of the reactor were found to be sufficiently large so that the regions removed from the boundary have a constant energy spectrum and the effect of the reflector is not noticeable; at the periphery slow neutrons from the reflector were found. The differential distribution is most noticeable at the boundary of the core and reflector. (TTT)

8433 HECTOR. NEW WINFRITH REACTOR OSCILLATES SPECIMENS UNDER SIMULATED POWER REACTOR CONDITIONS. Nuclear Eng., 7: 12-13(Jan. 1962).

The Hot Enriched Carbon-moderated Thermal Oscillator Reactor (Hector) which makes use of the pile oscillator technique for evaluating the nuclear behavior of fuels, moderators, and structural materials is now being constructed at AEE Winfrith. Specimens are oscillated in a vertical channel of the reactor which simulates the conditions obtained in typical power reactors. The reactor is built around a central zirconium vertical void tube located in a removable central test region of about 3-ft diameter. The test lattice, which can be heated to 450°C, can be loaded with either irradiated or unirradiated fuel. The central test region is driven by highly enriched uranium contained in an annular region around the central column. A pertinent feature of the design is the extremely high degree of temperature stability. (N.W.R.)

SPACE APPLICATIONS AND TECHNOLOGY

8434 (ASD-TR-61-147) NORMAL SPECTRAL REFLECTANCE OF ANODIZED COATINGS ON ALUMINUM, MAGNESIUM, TITANIUM AND BERYLLIUM. J. E. Janssen, R. H. Torborg, J. R. Luck, and R. N. Schmidt (Honeywell Research Center, Hopkins, Minn.). June 1961. Contract AF33(616)-6191. 289p.

Selection of materials having proper thermal radiation properties permits the engineer to achieve passive temperature control in spacecraft. The object of this investigation was to study the effect of various variables in the anodizing process on the reflectance of anodized metals. The integrating hemisphere was modified by adding a diffuser and then locating the sensor external to the hemisphere so that measurements could be made over the range of 0.4 to 22 microns in vacuum with specimen temperatures from 100 to 1300°F. Methods for extending both the spectral and temperature ranges are discussed. Normal spectral reflectance data on 158 specimens of anodized aluminum, magnesium, titanium, and beryllium are presented. Aluminum anodized in sulfuric acid gave a ratio of solar absorbance to infrared emittance of about 0.3 while A110AT titanium anodized in sodium hydroxide gave a value of $\alpha/\epsilon = 7$. In general, the anodizing process had a greater effect on the reflectance than did alloying elements in the metal. Measurements at elevated temperatures indicated a loss of water from coatings that contained water. (auth)

8435 NUCLEAR ROCKET PROPULSION. Hans von Ubisch. Astronautik, 2: No. 1, 30-44(1960). (In Swedish)

The feasibility of nuclear rocket propulsion is discussed, mostly in accordance with the recent monograph by Bussard and DeLauer. The successful experiments with thermoelectric power conversion are also shown to give an impetus to the development of advanced propulsion systems. The possibility and purpose of the photon rocket are examined. (N.W.R.)

8436 THE USE OF HYDROGEN IN NUCLEAR ROCKETS. O. H. Wyatt (Hawker Siddeley Nuclear Power Co., [London]). J. Brit. Interplanet. Soc., 18: 240-5(Sept.-Dec. 1961).

A review is given of three papers by Wyatt, Newgard and Levoy, and Sams on the use of nuclear rockets with hydrogen propellent as single-stage Earth satellite launchers. They agree on the parameters and performances tabulated. The reactor core will be homogeneous uranium-235/graphite in the form of cylinders between 3 and 12 ft in diameter, with voidage up to 0.5. With a 6-in. beryllium reflector, the minimum size may be determined by the maximum uranium concentration (here 1 ^{235}U : 500 C) which does not reduce the mechanical strength, rather than the cost of the fuel investment. The maximum core temperature will be about 2500°C; the maximum propellent temperature 2000°C, giving a specific impulse of 750 lb wt. sec/lb; and the power density around 200 Mw/ft.^{3} The payload for a 300-mile orbit will be up to 10% of the gross rocket mass, which for the above cores ranges from 10^5 to 7×10^6 lb, with thrusts about double these values. (auth)

8437 HEARINGS BEFORE THE SUBCOMMITTEE ON RESEARCH, DEVELOPMENT, AND RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SEVENTH CONGRESS, FIRST SESSION ON NUCLEAR ENERGY FOR SPACE PROPULSION AND AUXILIARY POWER, AUGUST 28 AND 29, 1961. (United States. Congress. Joint Committee on Atomic Energy). 320p. (GPO).

The public hearings cover the progress being made in the development of nuclear rockets and other atomic energy devices for use in space. The hearings cover the developments in the joint AEC-NASA nuclear rocket program (Project Rover), the development of long-lived nuclear power supplies (SNAP program), and the development of a nuclear ramjet engine to power missiles traveling in the atmosphere (Project Pluto). (N.W.R.)

WASTE DISPOSAL AND PROCESSING

8438 (HW-71752) IN-TANK SOLIDIFICATION OF WASTES BY SUBMERGED COMBUSTION. J. Dunn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 13, 1961. Contract AT(45-1)-1350. 9p.

Submerged combustion, using propane gas as the fuel, is an efficient means of reducing the volume of synthetic waste solutions contained in 10 foot diameter 5,000 gallon capacity tanks. It is felt that equal success may be possible in the 75 foot diameter underground storage tanks employing heated air. However, additional data must be obtained on circulation scale-up phenomena, hydration and delequesence chemistry, and process control techniques. In the test equipment used, the combustion product gas temperature was easily held to a temperature below 800°C for control of entrainment of droplets or solids in the off-gas stream. Concentration of solutions of sodium carbonate and of simulated Purex alkaline waste supernate to essentially complete solidification was readily accomplished. The use of an "air-lift circulator" surrounding the combustion chamber provided sufficient agitation to prevent localized build-up of solids on the bottom of the vessel during tests wherein the solution was concentrated to less than 45% of its original volume; i.e., to the point where solidification was essentially complete on cooling. Self-monitoring electronic components and timed purging features of the combustion ignition controlled functioned to prevent flash-back or uncontrolled ignition. (auth)

8439 (ORNL-3204) RECOVERY OF STRONTIUM AND RARE EARTHS FROM PUREX WASTES BY SOLVENT EXTRACTION. R. P. Wischow and D. E. Horner (Oak Ridge National Lab., Tenn.). Jan. 29, 1962. Contract W-7405-eng-26. 50p.

A solvent extraction flowsheet was developed for recovery of strontium-90 and mixed rare-earth fission products from adjusted Purex 1WW waste solution by di(2-ethylhexyl)phosphoric acid (D2EHPA) in Amsco 125-82 modified with tributyl phosphate (TBP). First cycle feed is prepared by adding tartrate and caustic to the waste solution to complex the iron and adjust the pH. Strontium and rare earths are coextracted with D2EHPA-TBP-Amsco and stripped with nitric acid in the first cycle, and then isolated as concentrated product solutions by processing through additional solvent extraction cycles. Satisfactory product recoveries and physical operation were demonstrated in bench-scale batch and continuous countercurrent tests with simulated, unirradiated, feed solutions. (auth)

8440 (UCRL-6641) A DECONTAMINATION PROCESS FOR LOW-LEVEL WASTE WATERS. R. J. Graham, E. L. Beard, and D. J. Kvam (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 27, 1961. Contract W-7405-eng-48. 21p.

Chemical treatment using flocculation techniques and filtration with rotary drums has been very successful in the LRL liquid-waste disposal program. Pilot runs combining the two methods gave volume reductions in excess of 99.5%. With proper selection of a precoat material in the filtering operation, the optimum condition of high flow and maximum decontamination was achieved. Emulsified liquids, such as machine coolants and cutting oils, can be successfully decontaminated if the emulsion is broken and a large part of the oil removed prior to chemical treatment. (auth)

8441 PROCESSING LIQUID RADIOACTIVE WASTES AT ARGONNE. H. Gladys Swope (Argonne National Lab., Ill.). J. Water Pollution Control Federation, 33: 871-80 (Aug. 1961).

A brief review is given first on the sewage treatment plant, which handles sanitary sewage, the laboratory waste treatment plant, and a special plating waste treatment plant. The four main methods of processing radioactive aqueous wastes are filtration, flocculation, cation exchange, and evaporation and concentration. If suspended solids are present and gross radioactivity is <500 cpm/ml, filtration is used. Filtration is always used prior to the cation exchanger so the exchanger will not act as a filter. In the strictest sense flocculation is not used at Argonne. A 3.5 ft^3 cation exchanger is used or processing wastes with a total solids content of less than 1000 mg/l, gross activity of less than 2000 cpm/ml, and pH between 1 and 7.5. Aqueous wastes which cannot be processed by the other three methods are evaporated unless the wastes contain ammonium nitrate, which requires special treatment. The two types of organic wastes, inflammable solvents and oils, also require separate handling. (P.C.H.)

8442 THE TREATMENT OF LOW ACTIVITY AQUEOUS WASTES. A. C. Cartwright ([Nuclear Power Plant Co., Ltd., Knutsford, Ches., Eng.]). Nuclear Eng., 7: 26-8(Jan. 1962).

The equipment and treatment methods for processing low-activity aqueous wastes at the Latina nuclear power station are discussed. The effluent treatment plant serves two purposes: purification of cooling pond water and decontamination of aqueous wastes from such outlets as regenerant solutions, active laundry and change houses, decontamination center, coffin washing, and charge machine washing. The treatment process consists of chemical precipitation followed by filtration of the sludges thus produced. The process is then followed by ion exchange on a natural inorganic material such as vermiculite and evaporation. This process produces a decontamination factor of 10^3 to 10^4. (N.W.R.)

8443 RADIOAKTIVE SUBSTANZEN UND WASSER. Eine Dokumentation. Mit 42 Abbildungen 2., Überarbeitete und Erweiterte Auflage. (Radioactive Materials and Water. A Review). Walther Kumpf, Bernd Dieterich, and Joachim Kumpf. Schriftenreihe GWF: Wasser · Abwasser Nr. 2. Munich, R. Oldenbourg Verlag, 1960. 279p. DM 28.

Ways in which water is contaminated by radioactive materials are outlined. Radioactive waste material processing is discussed. The harmfulness of radioactive material is considered and the highest permissible concentrations in water are given. Administrative precautions for protection of the population and the water are listed. Methods of measuring radioactivity in water are described. Separation of radioactive materials by preparation of drinking water is discussed. Purification of radioactive waste water is described. The retention of radioactivity in surface water and radioactive fallout are discussed. A glossary, author index, keyword index, and bibliographical listing are included. (M.C.G.)

8444 METHOD OF REDUCING AQUEOUS RADIOACTIVE NUCLEAR WASTES TO SOLID FORM. (to U. S. Atomic Energy Commission). British Patent 886,004. Jan. 3, 1962.

A method for converting aqueous radioactive wastes to

solids is described which comprises spraying the waste solution into a fluidized bed of oxides of the cations present in the waste solution, heating the bed, and removing solid radioactive products from the base of the bed. A fluidized bed calciner for use in this way is described. Volatilization of ruthenium from the solution may be prevented by employing as the fluidizing medium a mixture of carbon monoxide and nitrogen instead of air. (D.L.C.)

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æ	becomes	ae
ö		oe
ø		oe
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REPORT NUMBER INDEX

All reports, translations, and patents abstracted in this issue are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show, when known, which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

The report number codes apply to AEC reports unless designated otherwise. Non-AEC reports are identified by parenthetical notes after the report codes; e.g., (non-AEC), (British), (Canadian), (French). The note (Misc.) identifies those codes used for both USAEC and non-AEC reports. The report numbers for the non-AEC reports in these series are marked with an asterisk (*). Patents are listed under the heading "PATENTS"; the country of origin is included in parentheses.

A comprehensive listing of both AEC and non-AEC report codes is contained in TID-85(2nd Rev.), *Report Number Series Used by the Technical Information Service in Cataloging Reports*. March 1960, $2.75 (OTS), and supplement, August 1960, $0.50 (OTS).

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DTI Extension	Available from the U. S. Atomic Energy Commission, Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee.
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IAEA	Available from the International Atomic Energy Agency.
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NRC	For sale by the National Research Council of Canada, Ottawa, Ontario, Canada.
OTS	For sale by the Office of Technical Services, Department of Commerce, Washington 25, D. C.
USGS	Available free-of-charge from the U. S. Geological Survey, Washington 25, D. C.

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Report No.	Abstract No.	Availability
A-AC–	**(Misc.)**	
82/G/L.647*	16-7403	
82/G/L.648*	16-7404	
82/G/L.685*	16-7761	J. Radiation Research (Japan), 2: No. 1, 29-41(1961)
82/G/L.686*	16-7760	J. Radiation Research (Japan), 2: No. 1, 25-8(1961)
82/G/L.687*	16-7706	7 p. of J. Radiation Research (Japan), 2: No. 2(1961)
82/G/L.688*	16-7782	2 p. of Papers Meteorol. and Geophys. (Tokyo), 12: No. 2(1961)
ACNP–		
6118	16-7824	Dep.; $1.25(OTS)
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4468	16-7900	Dep.; $0.75(OTS)
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4679	16-7942	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
4741	16-7960	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
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4895	16-7485	Dep.(mc); $1.10(fs), $0.80(mf) JCL
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4991	16-7961	Dep.(mc); $3.60(fs), $1.40(mf) JCL
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1388	16-7660	See NEI-156
1389	16-7519	See CRCE-1039
1408	16-7955	See PR-P-51
AEET-ANAL–	**(Indian)**	
1(Rev.)	16-7477	Dep.(mc)
2(Rev.)	16-7478	Dep.(mc)
AEET-TP–	**(Indian)**	
2	16-7673	Dep.(mc)
AERE-Bib–	**(British)**	
121(Suppl.)	16-8258	See CLM-BIB-1
AERE-M–	**(British)**	
518(Amended)	16-7838	Dep.(mc)
742	16-7577	Dep.(mc)
AERE-R–	**(British)**	
3313	16-7501	Anal. Chim. Acta 25: 587-97(1961)
3784	16-7479	Dep.; $0.84(BIS)
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1525*	16-7674	
AGN–	**(Misc.)**	
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6375	16-7874	Dep.; $0.50(OTS)
6397	16-7924	Dep.; $1.25(OTS)
6459	16-8156	Dep.; $0.75(OTS)
6472	16-7518	Dep.; $2.00(OTS)
ANL-FGF–		
268	16-7715	Rev. Sci. Instr. 32: 1114-16(1961)
APAE–	**(Misc.)**	
75*	16-8344	
APAE-Memo–	**(Misc.)**	
300	16-8345	Dep.(mc); $4.60(fs), $1.55(mf) OTS
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902	16-8346	Dep.(mc); $7.60(fs), $2.36(mf) OTS
911	16-7624	Dep.(mc); $6.60(fs), $2.09(mf) OTS
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2230-3	16-7875	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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61-147	16-8434	OTS
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125	16-7860	Dep.(mc); $1.10(fs), $0.80(mf) OTS
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1145	16-8347	Dep.(mc); $8.60(fs), $3.11(mf) OTS
1231	16-8301	Dep.; $3.00(OTS)
BLG–	**(Belgian)**	
66	16-8428	Dep.(mc)
BM-RI–	**(Misc.)**	
5895*	16-7840	Free (Bureau of Mines)
5918*	16-7609	
BNL –		
675	16-7405	Dep.; $3.00(OTS)
702	16-7825	Dep.; $0.50(OTS)
4893	16-7367	p.164-9 of "Clinical Aspects of Nuclear Medicine" Cologne, Westdeutscher Verlag, 1961
5107	16-7427	Appl. Microbiol. 9: 410-14(1961)
5558	16-7416	See BNL-675(p.200-3)
5562	16-7420	See BNL-675(p.262-86)
5572	16-7569	J. Phys. Chem. 66: 164-6(1962)
5645	16-8213	Phys. Rev. 125: 275-6(1962)
CEA–		
56(MH)	16-8244	See TID-13717
63(MH)	16-8245	See TID-13718
69(MH)	16-8246	See TID-13719
83(MH)	16-8247	See TID-13720
1693	16-7355	10 p. of Prods. pharm. 16: No. 4(1961)
1730	16-8161	J. phys. radium 22: 193-203(1961)
1793	16-7349	Ann. fals. et expert. chim. 53: 520-31(1960)
1801	16-7986	J. phys. radium 22: 337-48(1961)
1802	16-8115	Nuovo cimento (10), 19: Suppl. No. 2, 207-20(1961)
1804	16-7640	J. phys. radium 22: Suppl. to No. 2, 39A-42A(1961)
1805	16-8182	J. phys. radium 22: 303-7(1961)
1972	16-7532	Compt. rend. 251: 1733-5(1960)
2000	16-7705	J. phys. radium 22: Suppl. to No. 2, 64A-7A(1961)
2019	16-7870	Compt. rend. 252: 3989-91(1961)
2061	16-7592	J. chim. phys., 506-7(1961)
CEA-tr–	**(French)**	
A-965	16-7962	Dep.(mc); $1.10(fs), $0.80(mf) JCL
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X-336	16-7617	Dep.(mc); $1.10(fs), $0.80(mf) JCL
X-397	16-7817	Dep.(mc); $3.60(fs), $1.16(mf) JCL
X-423	16-7583	Dep.(mc); $1.10(fs), $0.80(mf) JCL
X-428	16-7528	Dep.(mc); $2.60(fs), $0.92(mf) JCL
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61-5-109(Suppl.3)	16-7625	Dep.(mc); $1.10(fs), $0.80(mf) OTS
CISE-R–	**(Italian)**	
26	16-7658	See EURAEC-43
40	16-7853	See EURAEC-151
CLM-Bib–	**(British)**	
1	16-8258	Dep.; $0.56(BIS)
CLM-R–	**(British)**	
12	16-8259	Dep.; $0.56(BIS)
CNEN–	**(Italian)**	
58	16-7597	Nature 186: 632-3(1960)
103	16-7676	Dep.(mc)

Report No.	Abstract No.	Availability
CRCE–	**(Canadian)**	
1039	16-7519	Dep.; $1.00(AECL)
CRE–	**(Canadian)**	
1048	16-8302	Dep.; $2.00(AECL)
CURF-R–	**(Canadian)**	
9	16-7887	See NP-11168
CVNA–	**(Misc.)**	
54(Rev.1)	16-7520	Dep.(mc); $7.60(fs), $2.60(mf) OTS
DC–	**(Misc.)**	
55-11-11	16-7925	Dep.(mc); $4.60(fs), $1.49(mf) OTS
55-12-81	16-7926	Dep.(mc); $10.50(fs), $4.13(mf) OTS
56-12-29	16-8348	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-5-107	16-7876	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-5-173	16-7826	Dep.(mc); $2.60(fs), $0.98(mf) OTS
57-6-126	16-8349	Dep.(mc); $14.00(fs), $6.35(mf) OTS
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58-2-195	16-8288	Dep.(mc); $2.60(fs), $0.98(mf) OTS
58-2-215	16-7877	Dep.(mc); $1.10(fs), $0.80(mf) OTS
58-2-710	16-7626	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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58-3-128	16-8351	Dep.(mc); $5.60(fs), $1.82(mf) OTS
58-3-147	16-7656	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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58-4-195	16-7627	Dep.(mc); $3.60(fs), $1.40(mf) OTS
58-4-212	16-7828	Dep.(mc); $5.60(fs), $1.76(mf) OTS
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58-5-97	16-8304	Dep.(mc); $2.60(fs), $0.92(mf) OTS
58-6-152	16-7878	Dep.(mc); $2.60(fs), $0.86(mf) OTS
58-6-221	16-8157	Dep.(mc); $1.10(fs), $0.80(mf) OTS
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59-3-188	16-7882	Dep.(mc); $2.60(fs), $1.07(mf) OTS
59-5-221	16-8356	Dep.(mc); $4.60(fs), $1.43(mf) OTS
59-5-234	16-7678	Dep.(mc); $2.60(fs), $1.07(mf) OTS
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59-7-4	16-8308	Dep.(mc); $7.60(fs), $2.54(mf) OTS
59-7-114	16-7628	Dep.(mc); $6.60(fs), $2.06(mf) OTS
59-7-129	16-7629	Dep.(mc); $3.60(fs), $1.25(mf) OTS
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59-9-223	16-7767	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-10-101	16-7630	Dep.(mc); $12.50(fs), $5.54(mf) OTS
59-10-116	16-7929	Dep.(mc); $6.60(fs), $2.06(mf) OTS
59-10-135	16-8164	Dep.(mc); $2.60(fs), $1.01(mf) OTS
59-10-153	16-7841	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-10-174	16-7842	Dep.(mc); $2.60(fs), $0.83(mf) OTS
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60-8-67	16-8357	Dep.(mc); $6.60(fs), $2.24(mf) OTS
60-8-94	16-7843	Dep.(mc); $3.60(fs), $1.25(mf) OTS
60-8-121	16-7680	Dep.(mc); $2.60(fs), $0.92(mf) OTS
60-8-122	16-7930	Dep.(mc); $2.60(fs), $0.92(mf) OTS
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60-8-736	16-7844	Dep.(mc); $1.10(fs), $0.80(mf) OTS
60-9-46	16-7681	Dep.(mc); $2.60(fs), $1.01(mf) OTS
60-9-75	16-8165	Dep.(mc); $7.60(fs), $2.51(mf) OTS
60-9-76	16-8166	Dep.(mc); $1.10(fs), $0.80(mf) OTS
60-10-16	16-7932	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-10-17	16-7845	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-10-40	16-7657	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-10-75	16-7682	Dep.(mc); $4.60(fs), $1.61(mf) OTS
60-10-76	16-8309	Dep.(mc); $2.60(fs), $0.89(mf) OTS
60-11-51	16-8158	Dep.(mc); $5.60(fs), $1.73(mf) OTS
60-11-73	16-7683	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-12-95	16-7933	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-12-141	16-7952	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DCL–		
57-7-37	16-7861	Dep.(mc); $1.10(fs), $0.80(mf) OTS
58-2-39	16-7862	Dep.(mc); $1.60(fs), $0.80(mf) OTS
58-12-17	16-7846	Dep.(mc); $1.10(fs), $0.80(mf) OTS
DEG-Report–	**(British)**	
362	16-7790	p.47-118 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961.
DLCS–		
1510206 through 11	16-8366	See TID-12965
3070202	16-8358	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3450104	16-8369	See TID-14640
3450105	16-8369	See TID-14640
3500258	16-8367	See TID-12966
3500259	16-8367	See TID-12966
3570302	16-8359	Dep.(mc); $2.60(fs), $0.83(mf) OTS
DP–		
311	16-8092	Dep.(mc); $2.60(fs), $0.86(mf) OTS
457	16-8310	Dep.(mc); $8.10(fs), $2.72(mf) OTS
601	16-7610	Dep.; $0.50(OTS)
644	16-8093	Dep.; $1.00(OTS)
653	16-7611	Dep.; $0.50(OTS)
664	16-7831	Dep.; $0.50(OTS)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
DXRL–	**(New Zealand)**	
1	16-7768	Dep.(mc)
EURAEC–		
43	16-7658	Dep.(mc); $6.60(fs), $2.09(mf) OTS
151	16-7853	Dep.(mc); $8.60(fs), $3.17(mf) OTS
FTD-TT–	**(Non-AEC)**	
61-111	16-7963	OTS
61-183	16-8105	OTS
61-228	16-7964	OTS
GA–	**(Misc.)**	
2375	16-8274	Phys. Fluids 4: 1558-64(1961)
2603	16-8360	Dep.(mc); $2.60(fs), $1.01(mf) OTS
GAMD–	**(Misc.)**	
1221	16-7684	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1457	16-8311	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2476	16-7885	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2657	16-8312	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GEAP–	**(Misc.)**	
3538	16-8361	Dep.; $3.00(OTS)
3808	16-7934	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GEMP–		
70	16-7685	Dep.; $0.75(OTS)
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154	16-8362	Dep.; $1.25(OTS)
155	16-8313	Dep.; $1.75(OTS)
177	16-8363	Dep.; $1.25(OTS)
187	16-8290	Dep.; $1.00(OTS)
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50257	16-8094	Dep.(mc); $4.60(fs), $1.43(mf) OTS
66600	16-7808	Dep.(mc); $3.60(fs), $1.13(mf) OTS
67151	16-7659	Dep.(mc); $3.60(fs), $1.34(mf) OTS
68600-11	16-7338	Dep.(mc); $1.10(fs), $0.80(mf) OTS
68807 and (Add.)	16-8314	Dep.(mc); $2.60(fs), $1.07(mf) OTS
69631	16-7612	Dep.(mc); $1.60(fs), $0.80(mf) OTS
70859	16-7886	Dep.; $5.60(fs), $1.88(mf) OTS
70949	16-7383	Dep.; $0.50(OTS)
71752	16-8438	Dep.(mc); $1.10(fs), $0.80(mf) OTS
71811	16-8315	Dep.; $1.75(OTS)

Report No.	Abstract No.	Availability
HW-SA-		
2365	16-7421	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-tr-		
30	16-7903	Dep.(mc); $1.10(fs), $0.80(mf) JCL
I-	**(Misc.)**	
A2049-14	16-7635	See TID-13928
IDO-		
14571	16-7522	Dep.; $0.50(OTS)
14575	16-7613	Dep.; $0.50(OTS)
16718	16-8159	Dep.; $0.50(OTS)
16724	16-8429	Dep.; $0.50(OTS)
IFA-EM-	**(Rumanian)**	
45	16-8095	Dep.(mc)
IS-		
353	16-7538	J. Appl. Phys. 33: Suppl., 296-302(1962)
JINR-	**(Russian)**	
D-774	16-8096	Dep.(mc)
P-797	16-8097	Dep.(mc)
P-809	16-8098	Dep.(mc)
JPL-TR-	**(Non-AEC)**	
32-196	16-7631	
JPRS-	**(Non-AEC)**	
10223	16-7967	OTS
10872	16-8431	OTS
10874	16-7487	OTS
11579	16-8080	OTS
11623	16-7775	OTS
11630	16-7970	OTS
11686	16-8081	OTS
11688	16-7476	OTS
11689	16-7488	OTS
11730	16-7425	OTS
K-		
1497	16-7832	Dep.; $0.50(OTS)
KFK-tr-	**(German)**	
57	16-7971	Dep.(mc); $8.10(fs), $2.63(mf) JCL or OTS
92	16-7618	Dep.(mc); $3.60(fs), $1.37(mf) JCL
LA-		
2625	16-7953	Dep.; $2.00(OTS)
LAMS-		
2649	16-7954	Dep.; $0.50(OTS)
MAB-	**(Non-AEC)**	
179-M	16-7863	
MATT-		
91	16-8260	Dep.(mc); $2.60(fs), $0.83(mf) OTS
MCW-		
1452	16-7614	Dep.; $0.75(OTS)
MF-	**(Misc.)**	
24	16-8262	See NYO-9763
MURA-	**(Misc.)**	
630	16-7833	Dep.; $0.50(OTS)
633	16-8241	Dep.; $0.50(OTS)
NAA-SR-		
5732	16-7686	Dep.; $0.50(OTS)
6425	16-7847	Dep.; $1.00(OTS)
6804	16-7480	Dep.; $0.50(OTS)
NDL-TR-	**(Non-AEC)**	
18	16-7769	
NEI-	**(Canadian)**	
156	16-7660	Dep.; $1.00(AECL)
NEVIS-		
97	16-8099	Dep.(mc); $2.60(fs), $0.95(mf) OTS
NMI-	**(Misc.)**	
1245	16-7864	Dep.; $1.25(OTS)
1249	16-7935	Dep.(mc); $2.60(fs), $1.10(mf) OTS
7204	16-7865	Dep.(mc); $2.60(fs), $1.01(mf) OTS
7243	16-8364	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NP-	**(AEC File No. for Non-AEC Reports)**	
11066	16-7770	Dep.(mc)
11139	16-7936	Dep.(mc)
11168	16-7887	
11174	16-8167	
11184	16-7866	
11191	16-7771	
11196	16-7888	
11198	16-7937	
11232	16-8023	Dep.(mc)
11239	16-8168	
11242	16-7894	
11250	16-7342	
11252	16-7343	
11253	16-7344	
11255	16-7345	
11269	16-8261	
11270	16-7744	
11277	16-7938	
NYO-		
9282	16-8100	Dep.(mc); $7.60(fs), $2.57(mf) OTS
9283	16-8101	Dep.(mc); $9.10(fs), $3.44(mf) OTS
9490	16-7834	Dep.(mc); $11.50(fs), $4.85(mf) OTS
9666	16-7632	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9690	16-7481	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9758	16-8102	Dep.(mc); $2.60(fs), $0.95(mf) OTS
9763	16-8262	Dep.(mc); $4.60(fs), $1.43(mf) OTS
9807	16-7633	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9849	16-7809	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10005	16-7867	Dep.; $0.50(OTS)
10008	16-7868	Dep.; $0.50(OTS)
10022	16-7578	Dep.; $0.75(OTS)
ORA-		
04653-1P	16-7662	See TID-14556
ORNL-		
3172	16-7402	Dep.; $2.50(OTS)
3204	16-8439	Dep.; $1.25(OTS)
ORNL-TM-		
35	16-7615	Dep.(mc); $2.60(fs), $1.04(mf) OTS
81	16-7475	Dep.(mc); $5.60(fs), $1.73(mf) OTS
ORO-		
461(Rev.)	16-7895	Dep.(mc); $8.60(fs), $3.17(mf) OTS
503	16-7422	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PAN-	**(Polish)**	
136	16-7523	Dep.
259/CHR	16-7579	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
881,887	16-7622	
883,275	16-7603	
885,891	16-8326	
885,937	16-8327	
885,955	16-7576	
886,004	16-8444	
886,017	16-7873	
886,018	16-8328	
886,019	16-7837	
886,030	16-7517	
886,089	16-7648	
886,165	16-8283	
886,189	16-7649	
886,232	16-7950	
886,294	16-7650	
886,317	16-8329	
886,320	16-7671	
886,323	16-8330	
886,360	16-8284	
886,394	16-7607	
886,404	16-8285	
886,446	16-8331	
886,466	16-7623	
886,470	16-8257	
886,513	16-8286	
886,634	16-7733	
886,667	16-7608	
886,675	16-7651	

Report No.	Abstract No.	Availability
886,712	16-7382	
886,794	16-7604	
886,829	16-7652	
886,874	16-8426	
886,915	16-8332	
887,043	16-7734	
887,049	16-7605	
887,052	16-7823	
887,142	16-8333	
887,145	16-8334	
887,146	16-8335	
887,148	16-7735	
887,178	16-8336	
887,196	16-7736	
887,197	16-8337	
887,252	16-8338	
887,265	16-7737	
887,266	16-7738	
887,267	16-7739	
887,268	16 -7740	
887,299	16-7672	
887,345	16-7852	
887,367	16-7653	
888,307	16-8339	
888,362	16-7741	
888,394	16-8340	
888,439	16-7742	
888,465	16-8341	
888,471	16-8287	
888,602	16-8342	
888,641	16-7654	
888,677	16-7655	
PATENTS	**(Danish)**	
88,777	16-7583	For French translation see CEA-tr-X-423
PATENTS	**(German)**	
1,080,931	16-7814	See AEC-tr-4984
PATENTS	**(Norwegian)**	
77,177	16-7816	See CEA-tr-X-282
PB–	**(Non-AEC)**	
171037	16-7869	See PLASTEC-6
PG-Report–	**(British)**	
268	16-7482	Dep.; $0.21(BIS)
PLASTEC–	**(Non-AEC)**	
6	16-7869	OTS as PB-171037
PM-R–	**(Canadian)**	
61-11	16-7887	See NP-11168
PPAD–		
395-D	16-8242	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PR-P–	**(Canadian)**	
51	16-7955	Dep.; $1.50(AECL)
R-AE–	**(Canadian)**	
4	16-7888	See NP-11196
RAI–		
200	16-7810	Dep.(mc); $4.60(fs), $1.70(mf) OTS
RFP–		
224	16-7803	p.477-90 of "Criticality Control in Chemical and Metallurgical Plant." Paris, European Nuclear Energy Agency, 1961.
RIA–	**(Non-AEC)**	
61-1344	16-8291	
RRL–	**(Misc.)**	
71	16-7580	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SC–	**(Misc.)**	
4655(RR)	16-7524	Dep.; $0.75(OTS)
SCTM–		
22-61-81A	16-7687	Dep.(mc); $1.60(fs), $0.80(mf) OTS
199-61(11)	16-7939	Dep.(mc); $1.60(fs), $0.80(mf) OTS
230-61(81)	16-7688	Dep.(mc); $1.60(fs), $0.80(mf) OTS
243-61(14)	16-7689	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SRO–		
63	16-8365	Dep.(mc); $1.60(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
STI-PUB–	**(International Atomic Agency)**	
37	16-8386	$10.00(IAEA)
TEI–		
789	16-7747	Dep.(mc); $2.60(fs), $0.98(mf) OTS
TID–		
3709	16-7339	Dep.; Free (DTI Extension)
8200(5th Rev.)	16-8316	Dep.; Free (DTI Extension)
12965	16-8366	Dep.(mc); $3.60(fs), $1.31(mf) OTS
12966	16-8367	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13000	16-7634	Dep.(mc); $18.00(fs), $8.75(mf) OTS
13041	16-7956	Dep.(mc); $11.00(fs), $4.55(mf) OTS
13198	16-8368	Dep.(mc); $6.60(fs), $2.27(mf) OTS
13510	16-8243	Dep.(mc); $3.60(fs), $1.31(mf) OTS
13717	16-8244	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13718	16-8245	Dep.(mc); $1.10(fs), $0.80(mf) OTS
13719	16-8246	Dep.(mc); $2.60(fs), $1.07(mf) OTS
13720	16-8247	Dep.(mc); $3.60(fs), $1.34(mf) OTS
13928	16-7635	Dep.(mc); $5.60(fs), $1.76(mf) OTS
14392	16-7957	Dep.(mc); $3.60(fs), $1.31(mf) OTS
14393	16-7661	Dep.(mc); $2.60(fs), $0.95(mf) OTS
14475	16-8103	Dep.(mc); $3.60(fs), $1.37(mf) OTS
14476	16-7346	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14556	16-7662	Dep.(mc); $6.60(fs), $2.24(mf) OTS
14565	16-7384	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14567	16-7423	Dep.(mc); $3.60(fs), $1.19(mf) OTS
14569	16-8169	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14630	16-7581	Dep.(mc); $4.60(fs), $1.67(mf) OTS
14631	16-7896	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14640	16-8369	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14647	16-7772	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14656	16-8263	Dep.(mc); $12.50(fs), $5.42(mf) OTS
14658	16-7812	Dep.(mc); $6.60(fs), $2.06(mf) OTS
14661	16-7582	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14691	16-7424	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14692	16-7347	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14742	16-7773	Dep.(mc); $26.00(fs), $10.62(mf) OTS
14745	16-7940	Dep.(mc); $2.60(fs), $0.89(mf) OTS
14763	16-7941	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14767	16-7690	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14771	16-8430	Dep.(mc); $16.00(fs), $7.67(mf) OTS
14789	16-7958	Dep.(mc); $9.60(fs), $3.56(mf) OTS
TRG-Report–	**(British)**	
127	16-8317	Dep.
UCLA–		
462	16-7400	Soil. Sci. Soc. Am. Proc. 25: 299-301(1961)
UCRL–		
5778	16-8225	Phys. Rev. 125: 335-40(1962)
6190	16-8222	Phys. Rev. 125: 311-18(1962)
6320	16-8104	Dep.; $1.50(OTS)
6352	16-8214	Phys. Rev. 125: 276-9(1962)
6485	16-8228	Phys. Rev. 125: 359-65(1962)
6554	16-8264	Dep.; $0.50(OTS)
6603	16-8084	J. Geophys. Research 67: 25-9(1962)
6641	16-8440	Dep.; $0.50(OTS)
6676	16-7663	Dep.; $1.75(OTS)
9505	16-8202	Nuclear Phys. 29: 109-19(1962)
9525	16-8203	Nuclear Phys. 29: 120-36(1962)
9555(Rev.)	16-7551	J. Chem. Phys. 36: 191-3(1962)
9621	16-8108	Ann. Rev. Nuclear Sci. 11: 1-40(1961)
9654	16-7550	J. Chem. Phys. 36: 189-90(1962)
9729	16-8209	Phys. Rev. 125: 256-61(1962)
9743(Rev.)	16-8254	Rev. Sci. Instr. 32: 1331-6(1961)
9839	16-7724	Rev. Sci. Instr. 32: 1380-2(1961)
9871	16-7959	Dep.; $1.00(OTS)
9872	16-8170	Dep.; $2.25(OTS)
9882	16-8171	Dep.; $2.00(OTS)
9908	16-7483	Dep.; $0.75(OTS)
13031	16-7748	Dep.(mc); $6.60(fs), $2.12(mf) OTS
UR–		
604	16-7348	Dep.; $3.60(fs), $1.28(mf) OTS
VDIT–	**(Swedish)**	

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47	16-7848	Dep.(mc)
WADC-TR–	**(Misc.)**	
57-344(Pt.V)*	16-7897	OTS
WADD-TR–	**(Non-AEC)**	
60-143(Pt.II)	16-7898	OTS
61-72(Vol.V)	16-7899	OTS
WAL-TR–	**(Non-AEC)**	
142.1/1	16-7745	
WAPD-AD–		
TH-545	16-7691	Dep.(mc); $8.10(fs), $2.84(mf) OTS
WAPD-R–		
(TH)-575	16-7692	Dep.(mc); $3.60(fs), $1.37(mf) OTS
WAPD-T–		
1078	16-7858	J. Electrochem. Soc. 109: 92-4(1962)
1367	16-8370	Dep.(mc); $8.10(fs), $2.87(mf) OTS
WAPD-TM–	**(Misc.)**	
228	16-7835	Dep.; $1.75(OTS)
303	16-8318	Dep.; $0.75(OTS)
WT–	**(Misc.)**	
1513	16-7749	Dep.; $0.75(OTS)
XDC–		
54-7-20	16-8371	Dep.(mc); $3.60(fs), $1.25(mf) OTS
55-5-123	16-8319	Dep.(mc); $1.60(fs), $0.80(mf) OTS
55-5-125	16-8320	Dep.(mc); $1.10(fs), $0.80(mf) OTS
59-8-206	16-8321	Dep.(mc); $5.60(fs), $1.85(mf) OTS
59-11-72	16-8322	Dep.(mc); $3.60(fs), $1.13(mf) OTS
60-4-2	16-7340	Dep.(mc); $21.00(fs), $9.55(mf) OTS
60-12-156	16-8372	Dep.(mc); $4.60(fs), $1.55(mf) OTS
Y–		
1376	16-7484	Dep.; $0.50(OTS)